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CONTENTS.

Editorial..... 445
International Thermal Units..... 446
Standardizing Lamp Bases and Sockets..... 447
President Nicholl's Interim Report..... 448
Alternating from Direct Currents..... 448
The New Station of the Long Island City Electric Illuminating & Power Company..... 449
The Rubber Industry of Nicaragua..... 450
Electrical Machinery of the Walker Company. (*Concluded*)..... 451
American Electro-Therapeutic Association..... 455
Electrolysis and Some Problems in Molecular Physics, by C. L. Mees. (*Concluded*)..... 456
Present Status of the Distribution and Transmission of Electrical Energy, by Louis Duncan. (*Concluded*)..... 457
Electrical Disturbances in Submarine Cables, by W. H. Preece..... 459
Digest of Current Electrical Literature, compiled by Carl Hering..... 462
New Books..... 467
Wooden Pipes for Electrical Conduits..... 467
Novelties in Miniature Lamps..... 468
Operating Under Difficulties..... 468
Röntgen-Ray Apparatus..... 468
Some New Designs in Arc Lamps..... 469
Graphite Rheostats..... 470
Electrically Driven Cable Railways..... 470
Press for Large Armature Discs..... 470
The Porter-Allen Engine..... 471
Departments:
Financial Intelligence..... 472
Special Correspondence..... 472
General News..... 474
Personal Notes..... 475
Trade and Industrial Notes..... 475
Business Notices..... 475
Illustrated Record of Electrical Patents..... 475

ELECTRO-THERAPEUTICS.

The leading position which electro-therapeutics has taken in the medical profession was to some extent demonstrated by the two important meetings, recently held, one that of the American Electro-Therapeutic Association, in Boston, and that of its offspring, judicious or otherwise, the National Society of Electro-Therapeutists, in New York City, reports of which meetings were given in our columns last week. Associations of this kind possess considerable interest to the electrician as well as to the physician, inasmuch as it is to the former that the electro-therapeutist has in the past looked for assistance, and will, at least for a few years to come, seek counsel. As the field widens and the older members become more familiar with its scope, and the medical colleges, which have thus far almost entirely ignored this development, have been forced to acknowledge its importance, we may expect to see the electro-therapeutist gradually absolving himself from the electrician's aid and independently establishing this new specialization in medical science. This change is not likely to come about until the study of electro-therapeutics has been put upon a sound basis, which will to a large extent be brought about by the adoption of a system of measurement founded upon the fundamental electrical units, by means of which system the applications of electricity to medicine may be made in an exact and quantitative manner. Past experience has fully demonstrated that most injurious results may be produced by injudicious electrical treatment, and owing to the inexactness of medical science it is only by careful and intelligent observation that electro-therapy can be firmly established. Perhaps the most beneficial effect to be derived from these organizations is that of exterminating to a large extent the present fraudulent and unscrupulous exponents of medical treatment by the aid of so-called electric appliances. Nearly every branch of industrial application which has a worthy and commendable side has also to a greater or less extent its unscrupulous votaries, and so it has naturally proved to be the case in electro-therapeutics. As the standing, however, of the associations becomes more pronounced and the benefits which they have rendered to medical science become more appreciated these "pretentious charlatans" will be forced to either abandon their vocations or adopt the methods of recognized authorities, while electro-therapeutics will be placed on a par with any other branch of the medical profession.

STANDARDIZING LAMP BASES AND SOCKETS.

A standard incandescent lamp base and socket has long been recognized as desirable, but hitherto no organized effort has been directed toward attaining any practical results in this line until President Nicholls of the National Electric Light Association, with commendable enterprise, took hold of the question with an evident determination of accomplishing something tangible, and with this object in view has succeeded in bringing together representatives of various manufacturers and others interested in the subject for the purpose of considering the proposition and securing if possible some united action thereon. The meeting was thoroughly representative in its character and almost its first act was to declare in favor of a standard base and socket. In the discussion which followed the deficiencies rather than the salient features of the several standard makes of lamps were considered, and it is remarkable that the most prominent lamp in the market suffered most from this criticism. This lamp, however, elicited from most of those present the opinion that it embodied to a greater degree than any other lamp the elements of a perfect

base and socket, and it was therefore provisorily decided that its features should form the basis for improvement. Owing to the existing patents on the Edison lamp socket it will be necessary to obtain the consent of the manufacturer for the use of the same, and for which purpose a committee was appointed. The question naturally presents itself what features should a standard or ideal base and socket possess? Among other considerations such a device should have a minimum number of parts; it should be weatherproof; it should have contact made otherwise than by means of current-carrying springs; it should have no metal sheathing, thus avoiding shocks, corrosion and to some extent short circuits; the socket should be so arranged that it can readily be screwed onto a fixture before connecting the conductors; it should be possible to turn the lamp in any position and in no case should it jar loose; it should be possible to place a lamp base in a socket with one hand only, without the danger of the lamp dropping, as it is liable to do where a screw connection is used; the connection between the base and socket should be firm and unfailing in order to avoid arcing, which is of common occurrence in some incandescent lamps by reason of imperfect contacts within the socket; the insulation of the parts within the socket should receive careful attention; the whole should be as cheap as possible consistent with good construction. One cause of short-circuiting within the socket is due to one or more ends of the lamp cord strands becoming loose so that a more reliable and expeditious means of connecting them with the terminals should be provided. It will doubtless be necessary to use an adapter of some sort in order to effect the transition from the present lamp base and socket to that of the standard form. By the use of such a device and the agreement of the manufacturers to make all future lamp bases and sockets according to the standard specifications to be adopted, the changes desired can doubtless be brought about. Some idea of the importance of the undertaking may be inferred from the fact that there are in use in this country about sixteen millions of incandescent lamps.

INCANDESCENT LAMP TESTS.

In a paper read before the Liverpool meeting of the British Association, Mr. Preece presents the results of a long series of tests on incandescent lamps. The tests in themselves are not particularly interesting to the American reader, inasmuch as no American makes were included, but the results and conclusions reached by Mr. Preece have considerable importance, and although the paper shows nothing in regard to the testing of lamps which has not been previously set forth, yet owing to its bearing upon the radical requirements which have been introduced in the British Post Office specifications for good lamps, it deserves the attention of all interested in the subject. Mr. Preece's tests were conducted for the purpose of determining the efficiency and life of 100-volt 16 and 8-cp lamps, during a test of 1000 and 2000 hours' duration respectively, the lamps burning continuously at a constant voltage; to determine the efficiency and life at constant voltage with intermittent periods of burning; to find the mean breaking voltage of filaments when increasing the voltage at a uniform rate and to see what effect would be produced by raising the voltage to three fourths of the mean breaking voltage. The results of the tests showed that lamps may be grouped in four classes, the first showing an initial high efficiency and nominal candle-power, but a decided falling off in both in from 400 to 500 hours; the second, starting with a nominal candle-power and giving a useful light for about 1000 hours and at that time burning out; the third showing qualities similar to the second, but not breaking; the fourth, starting with a candle-power below the nominal candle-power and maintaining the same for 2000 hours or more, the second and third qualities in Mr. Preece's estimation being the best for practical use. Mr. Preece found that the mean breaking voltage was about 230 volts, the voltage being gradually increased to the breaking point at a uniform rate for all lamps. He concludes that good 100-volt 3¼-watt 16-cp lamps should withstand a gradually increased pressure attaining 230 volts in 3½ minutes before the filament breaks, and that when such lamps are slowly and uniformly raised to three fourths of this voltage, the candle-power should not be lower than 14.4 nor higher than 17.6, and that the lamp should then require not exceeding four watts per candle. The results of Mr. Preece's experiments seem to show that the English are still without a satisfactory high efficiency lamp. Although the results of these tests, given as they are in an official manner, are pretty severe in some cases on the lamp makers, still they will have a beneficial effect, and it would be highly desirable if such tests could be carried out in this country on similar lines. Whether the test of breaking down a lamp by gradually increasing the voltage has any definite bearing on the normal burning of lamps remains to be seen. It is also to some extent questionable whether increasing the voltage during tests to three fourths of the normal breaking voltage —about 170 volts—is of value. Mr. Preece evidently thinks so, as he has incorporated this test in his specifications, and his experience is certainly to be most carefully considered. Although the specifications call for the photometric tests based upon the English standard candle, yet no definite information is given regarding the conditions under which the tests shall be made. The Post Office department has adopted the Trotter photometer, but it is as yet not settled whether the Vernon-Harcourt or the Heffner-Amyl-Acetate standard lamp will be used. These facts certainly leave the specifications in an incomplete condition, and require that they be materially modified and at the same time made more explicit before final adoption.

International Thermal Unit.

At the recent meeting of the British Association the Electrical Standards Committee provisionally approved a set of propositions relating to a thermal unit, and for the purpose of inviting international discussion of the question, proposes to send a copy of the propositions to representative bodies throughout the world. These bodies will be invited to take what action they may deem most desirable, with the view to bringing about international agreement on the matter. The propositions are as follows:

I. For many purposes heat is most conveniently measured in units of energy, and the theoretical C. G. S. unit of heat is 1 erg. The name Joule has been given by the Electrical Standards Committee to 10^7 ergs.

For many practical purposes heat will continue to be measured in terms of the heat required to raise a measured mass of water through a definite range of temperature.

If the mass of water be 1 gramme and the range of temperature 1 degree C. of the hydrogen thermometer from 9.5 degrees C. to 10.5 degrees C. of the scale of that thermometer, then according to the best of the existing determinations the amount of heat required is 4.2 Joules.

It will therefore be convenient to fix upon this number of Joules as a secondary unit of heat. This secondary thermal unit may be called a "Calory."

Accordingly for the present a second proposition is:

II. The amount of heat requisite to raise the temperature of 1 gramme of water 1 degree C. of the scale of the hydrogen thermometer at a mean temperature which may be taken as 10 degrees C. of that thermometer is 4.2 Joules.

If further research should show that the statement in II. is not exact, the definition could be adjusted by a small alteration in the mean temperature at which the rise of 1 degree takes place. The definition in I. and the number (4.2) of Joules in a Calory would remain unaltered.

Canadian Pacific Telegraphers' Strike.

The strike of the telegraph operators on the Canadian Pacific Railway was declared off on Oct. 7. Some concessions were made to the men touching the settlement of future grievances.

Standardizing Lamp Bases and Sockets.

The meeting of lamp and socket manufacturers called under the auspices of the National Electric Light Association, as already mentioned in THE ELECTRICAL WORLD, took place on Friday, Oct. 9, at the rooms of the American Institute of Electrical Engineers, in the Havemeyer Building, New York.

The General Electric Company was represented by Mr. A. D. Page and Lieut. M. K. Eyre, of the lamp works, Harrison, N. J., and Mr. H. C. Wirt of the socket and supply department, Schenectady ; the Buckeye Electric Company, by Mr. C. H. Rockwell ; the Bryan-Marsh Company, by Mr. Converse D. Marsh ; the Sunbeam Incandescent Lamp Company, by Mr. F. S. Terry ; the Perkins Electric Switch Manufacturing Company, by Mr. Chas. I. Hills ; the Bryant Electric Company, by Mr. W. C. Bryant ; the Anchor Electric Company, by Mr. A. B. Field ; the Electrical Engineering & Supply Company, by Mr. F. W. Hawkins. As representing lighting companies there were present : Mr. C. E. Scott, of the Bristol, Pa., Electric Light Company, and Mr. A. A. Pope, of the New York Edison Illuminating Company. There were also in attendance Mr. Elias E. Ries, who has had considerable experience in the manufacture of sockets, and Mr. S. Wheelwright, representing Mr. John E. Creiggal, of Newark, N. J.

The meeting was called to order by Mr. Frederic Nicholls, president of the National Electric Light Association. Mr. Nicholls said he would take the opportunity of stating in advance that on behalf of the association he had endeavored to bring together the several interests involved, for the purpose of trying to solve the somewhat difficult problem of standardizing the incandescent lamp socket and lamp base. The National Electric Light Association, he added, was absolutely impartial in the matter, but it was thought that more might be accomplished by holding such a meeting under neutral auspices than in any other way. He instanced the good results that had followed when street railway voltage was standardized at 500 volts. Prior to such standardization there had been considerable differences of voltage ranging from a few volts up to 1500. While he and others connected with the electric light industry appreciated that the standardizing of lamp sockets was not likely to be easily accomplished, he yet thought that after discussing the whole subject those interested would find some way out of the present dilemma.

Mr. Nicholls was unanimously chosen chairman of the meeting.

To elicit the views of the gentlemen on the general subject Mr. F. S. Terry offered the following resolution, which was promptly adopted : "It is the opinion of those present at this meeting that a standard lamp socket and lamp base are desirable."

This preliminary point settled, a general discussion followed as to the difficulties in the way of the establishment of a standard socket, and whether it would be more advantageous, everything else being equal, to adopt as a standard one of the principal sockets now in use or to decide upon a new one.

In the discussion the point was made that perhaps 70 per cent. of all the sockets in use in this country are those of the Edison variety, and that therefore the minimum of inconvenience would result from the selection of that socket as a standard. Mr. Terry offered a resolution that "the most desirable lamp base and socket, in itself considered, is a socket adapted for Edison base-lamps."

The Edison socket did not, however, have everything its own way. Mr. Ries favored the Sawyer-Mann (or Westinghouse) socket and base. He did not like the Edison method of inserting the lamp in the socket, and thought there was liability to breakage of bulbs from their slipping out of the hand in unscrewing, while the possibility of arcs forming where the lamps were not turned far enough to make a good connection he also considered an objection. He preferred the sliding contact of the Sawyer-Mann socket, particularly as when an Edison lamp is screwed home the filament is often turned sidewise in such a position with regard to the desk or space to be illuminated as to quite a little diminish the volume of light.

Mr. Scott was also opposed to the Edison base and socket, especially for use on steamships or in mills and factories where there is much vibration, as he had found from experience that in such situations the lamps gradually unscrewed themselves and gave trouble. Mr. Scott thought the Sawyer-Mann style of socket was preferable under such circumstances.

Mr. Page defended the Edison base and socket, and said that the objections mentioned had been appreciated and remedied by the General Electric Company. The Edison navy-base lamp, he added, which is in use on shipboard and other places where there is much vibration, is giving excellent satisfaction. Mr. Page also remarked on this head that the company is making the sockets of the Edison lamp a little longer than formerly, and that on account of a spring now inserted in the socket it is not necessary to screw a lamp absolutely home to insure a good contact.

It came out in discussion that the patents on the Edison base have probably expired, but that the socket patent will not expire until May 2, 1899. Mr. Page said, that from the standpoint of a lamp manufacturer, the standardization of the socket would be of so much advantage to the General Electric that although he was not authorized to state what the company would be willing to do with regard to the licensing of other manufacturers to make the Edison socket, should it be adopted as the standard, he would be heartily in favor of this being done. He hoped, moreover, that the licensees of the General Electric Company, who had an interest in the matter, would also feel that they would be sufficiently benefited to acquiesce in such licensing.

A committee, consisting of Messrs. Nicholls, Terry, Rockwell, Bryant and Hills, was then appointed to confer with the General Electric and its licensees, and report back at another meeting to be held at the call of the chairman.

Electric Light on Nansen's Steamer "Fram."

Some interesting particulars of the electric lighting plant on the steamer *Fram*, which conveyed Nansen and his party on the recent Arctic expedition, are given in a foreign contemporary. It is stated that the electric light gave great satisfaction, and general regret was expressed when, in May, 1895, Lieut. Sverdrup and Mr. Nordahl decided that it must be dispensed with, owing partly to the wearing out of the gearing of the cogwheel in the windmill, which worked the dynamo, after the vessel had entered the ice, and partly to the fact that portions of the apparatus were required for making snow-shoes and runners. Mr. Nordahl took advantage of every puff of wind to charge the accumulators, and until May last year the electric light was always available. In the severe cold the accumulators froze right through, but the acid-blended ice, it is stated, proved an excellent electrolyte, and the frost did not interfere with the working of the accumulators. Electricity was also used for other purposes besides lighting, the mining shots which set the *Fram* free from the grip of the ice being fired by means of a cable attached to six Leclanché cells.

In this connection it would be interesting to determine the action of different degrees of frost on the electrolyte of accumulators, and what alterations take place in the condition and working of a given cell, when frozen partially or solid. In a communication on this subject Mr. W. Perren Maycock, in the London *Electrician*, brings up some pertinent questions. It is contrary to the generally accepted theory that a cell under these conditions should work at all, because there can be no transmigration of the ions when the electrolyte is frozen solid, and even with it partially frozen impaired action would be expected. There is an opportunity here for some interesting investigations.

The Berliner Patent.

The Supreme Court of the United States is now in session at Washington, and it is thought that by next week will begin to hear arguments in the causes that have been advanced for hearing before that tribunal. Among the 54 causes that have been so advanced, the most important is that of the United States *vs.* the American Bell Telephone Company, a suit to amend the Berliner patent. The decision of the Court upon the questions involved will affect the different "opposition" telephone companies about as much as any other decision that has yet been rendered. The decision may be looked for within a short time.

American Institute of Electrical Engineers.

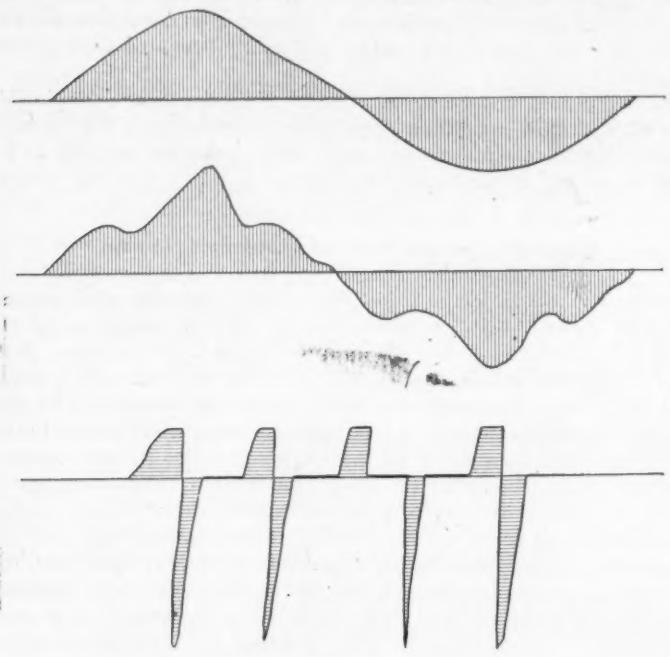
The next meeting of the Institute will be held at 12 West Thirty-first Street, on Wednesday evening, Oct. 21, and will be devoted to a topical discussion on the subject of "Electric Traction Under Steam Railway Conditions."

The discussion will be opened by Dr. Charles E. Emery, and prominent steam engineers as well as electrical engineers have accepted invitations to participate.

Arrangements are being made for a similar meeting to be held at Chicago the same evening.

Alternating from Direct Currents.*

In this paper entitled "A New System of Administering the Electric Current Therapeutically," Lieut. F. Jarvis Patten described a method for applying the electric current by producing an alternating current from a direct current by means of electrodes revolving in a receptacle containing acidulated water. Lieut. Patten stated that the method consisted in applying as nearly as possible a uniformly varying alternating current of absolutely unbroken continuity at a frequency of about one or two per second. He stated that he believed these to be essential features in the therapeutic application of alternating currents, the voltage following that of the true sine curve such as shown in Fig. 1. A voltage of this kind could be produced by a specially constructed dynamo, but it would be a difficult matter to get a low frequency condenser, as the lowest machine speeds would be too high.



FIGS. 1, 2 AND 3.

He stated that alternating currents for commercial machines often produced sudden and irregular changes of voltage, due to the presence of iron and rapid reversals. The irregular curve in Fig. 2 shows in a general way the current delivered by ordinary induction apparatus, and supplied with an interrupted current from a battery or other direct-current source. The changes in the voltage are sudden and irregular, and the breaks are of comparatively long duration. Fig. 3 represents approximately the voltage curve of a commercial alternator with iron armature, the fluctuations of voltage of which are not so irregular, but the frequency is very high.

An alternating current of uniformly varying voltage, free from sudden interruptions and of very low frequency, can be produced by properly designing the apparatus shown in Fig. 4. A circular vessel or tub containing acidulated water, is made of insulating material and provided with two carbon or platinum electrodes, C_1, C_2, which are connected to direct-current street-lighting mains, or to a battery as indicated. A vertical spindle in the centre of the vessel supports the horizontal arms, also of insulating material, and carrying at their extremities revolving carbon or platinum electrodes, C_3, C_4, which latter are connected to the insulating ring contacts, R_1, R_2, fixed on a spindle and upon which bear the contact brushes, H_1, H_2, from which the transformed current is taken to the operating circuits connected with the terminals, A_2, B_2. The current from a battery or house circuit being turned on, the movable electrodes are revolved slowly by an electric motor or clockwork, and a uniformly varying and unbroken alternating current of as low frequency as may be desired is delivered to the operating circuit, A_2, B_2, from which any desired form of electrode, or other means may be used to supply the current to the subject.

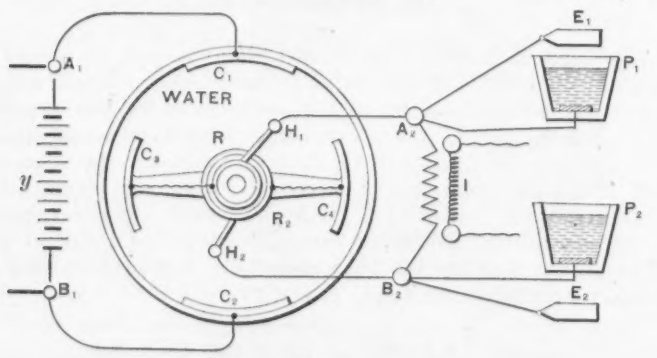


FIG. 4.

Among others there is indicated a pair of tubs or pails for immersing the hands or feet, thus giving a current to the upper and lower extremities of the body. The apparatus is very simple and cheap, cannot get out of order with ordinary use, and transforms an ordinary street-lighting current of 220 volts, or that of an ordinary battery, to a uniformly varying current of any desired voltage and frequency. If the battery is used the voltage will probably be too low, in which case the transformed battery current should be passed through an ordinary step-up transformer, which can be connected to give any desired voltage. Thus, with a dozen cells of storage battery and an ordinary 110-volt direct-current lighting circuit at his command, a physician with this apparatus can have what has some promise of being the best form of alternating current for medical use.

If the revolving plates or electrodes are made adjustable in position to and from the centre on the revolving arm, then by moving them toward the centre a liquid resistance is thrown in the operating circuit, thereby reducing the voltage of the street circuit by any desired amount. By thus connecting the revolving mechanism the water can be used as a mere passive resistance, so that the ordinary house-lighting circuit can be reduced in voltage sufficient to heat cauterizing instruments. The apparatus can be made in a compact form, about a foot or 15 inches in diameter for individual use, or larger if desired, to carry heavy currents for sub-division among many operating circuits.

*Abstract of paper read before the National Society of Electrotherapeutists.

President Nicholls's Interim Report.

In his second interim report to the members of the National Electric Light Association, President Frederic Nicholls sets forth the services which have been rendered and the work which the Executive Committee of the association has in hand. An increase of membership is noted and much greater interest is being taken in the work of the association. A supplementary report has been added to that of August last on the cost of arc lighting in the cities and towns of the United States. The president states that one of the most important standing committees of the association, the Committee on Data, has not in the past received the encouragement which it deserved. The Executive Committee has therefore adopted a different course. Mr. Swetland, chairman of the Committee on Data, and Mr. Nicholls have carefully considered the scope of the report to be submitted next year to the association, and have retained a practical engineer of high standing to personally visit a number of central stations and gather information decided upon as necessary. This report the president believes will be the most valuable publication ever issued by the association, and will be printed in book form and ready for distribution, it is hoped, by March 1 next.

The question of consolidating the National Electric Light Association and the American Street Railway Association has been considered and in response to a letter from President Nicholls to the president of the latter association, Mr. H. M. Littell, the Executive Committee of this association desired that Mr. Nicholls appoint three representatives of the National Electric Light Association engaged exclusively in the lighting business to confer with three representatives of the American Street Railway Association engaged exclusively in the street railway business, and that these, gentlemen consider the subject fully. In compliance with this suggestion Mr. Nicholls has appointed Mr. W. S. Barstow, Brooklyn, N. Y.; Mr. Henry Clay, Philadelphia, Pa., and Mr. Charles E. Scott, Bristol, Pa.

Legal opinion regarding the rights of lighting companies to the use of streets for overhead wires was submitted by Mr. Eugene H. Lewis, attorney, at the request of President Nicholls. The opinion cites several decisions bearing upon this question.

The subject of the standardization of an incandescent lamp socket and base was also considered, and the results of the conference held in this city will be found elsewhere in this issue.

The New Station of the Long Island City Electric Illuminating & Power Company.

ADJOINING the station of the Steinway-Electric Company in Astoria is that of the Long Island City Electric Illuminating & Power Company. This latter company was organized to supply light and power to the territory surrounding the station, and is rapidly building up an equipment which will have an ample capacity to meet all the requirements for some time to come.

The boiler-house is a spacious affair abutting the river front and has splendid facilities for handling coal. The latter is drawn from a coal pocket directly at the river front and wheeled into the boiler-room where scales are provided for weighing each load.

There are four Caldwell boilers of the water-tube type, each of which is rated at 400 horse-power. The feed-water is obtained from the city mains, and owing to the mineral constituents which it contains has caused some trouble by the production of scale in the boilers, but with the use of a compound trouble due this cause is largely avoided. Two tandem-compound duplex Worthington feed-pumps supplemented by four injectors form the feeding system of the boilers. The injectors are used in case of emergency only. The boilers deliver their flue gases to a stack 195 feet high and 9 feet 6 inches in diameter at the base. The stack is lined to a height of 110 feet with fire-brick. The steam pressure is 125 pounds, but the steam piping system is designed for 150 pounds pressure.

The ash pits consist of inverted hollow pyramids, which send the ashes down into a suitable mouthpiece below the boiler-room floor. These openings are closed by gates operated by hand mechanism. A cart can be wheeled under any one of them, and the ashes from two boilers can thus be at once removed. A view of this arrangement is obtained by an inspection of Fig. 3, while a general view of the boiler room, showing two of the four boilers, may be seen in Fig. 4. A duplicate steam piping system is provided with corrugated expansion joints, and will be covered throughout with magnesia. It passes underneath the flooring to the engines.

The station will supply high-tension direct currents for arc lighting, simple alternating currents at ordinary commercial pressures, and two-phase alternating currents for power purposes.

The arc generators are driven by two Dixon-Corliss engines built by the Wright Steam Engine Works. A view of one of these engines is given in Fig. 5, the second being in course of erection. The engines are tandem compound, and have a stroke of 48 inches. Two separate eccentrics drive the cut-off, and release valves of either cylinder. A fly-wheel with a 50-inch face carries a 48-inch belt which is cast in sections, and bolted together about the shaft.

FIG. 1.—500-HP WILLIAMS IMPROVED VERTICAL ENGINE.

These engines are belted to a jack-shaft shown in Fig. 6, which is provided with a number of pulleys, each of which is secured to it by a clutch. The shaft was built by the Falls Rivet & Machine Company, Cuyahoga Falls, O.

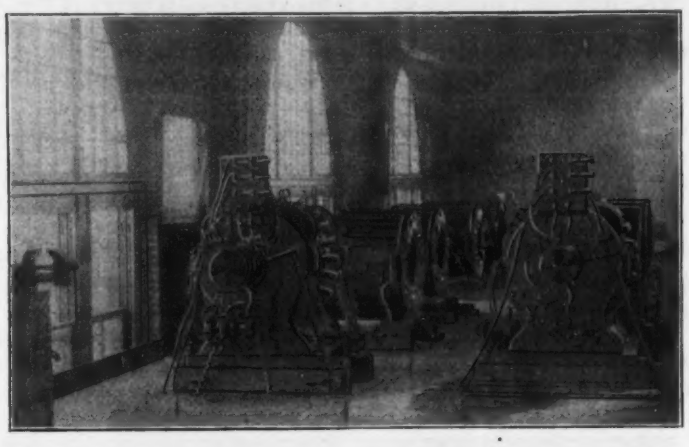


FIG. 2.—ARC PLANT.

To this shaft is belted a number of arc machines which are shown in Fig. 2. There are eight 50-light T.-H. machines of the familiar type, running at 860 revolutions per minute, ring wound, and capable of supplying nine amperes at 2500 volts. There are also two 80-light Brush machines wound on the three-circuit plan, but at present so connected as to deliver their entire output to a single circuit. These machines have 24 bobbins and four fields and produce 9.6 amperes at 1400 volts while running at a speed of 700 revolutions per minute. Each machine is controlled at a small plug switchboard which is of marble and contains the wall controllers of all the machines, the ammeters and lightning arresters, the plugs serving to connect any of the machines to any of the circuits. This board, which is a neat and attractive affair, is, nevertheless, inadequate for the demands upon it and will presently be replaced by a larger and more convenient one.

The Westinghouse two-phase generators are driven by two upright engines built by William Todd & Co. One is connected to a 500 and the other to a 300-kw generator, the former being mounted on the engine shown in Fig. 1.

The primary voltage will be 2200, and the frequency 7200 per minute. Each machine has 50 field coils and runs at a speed of 150 revolutions per minute. The only difference between the two is in the winding of the armature and its length. The engines have gridiron valves and both high and low pressure cylinders are governed by a fly-wheel governor. Each engine is supplied with a cast sectional fly-wheel held together by wrought iron links, the

periphery of the wheel having holes for the purpose of turning it over, in case such is required before starting. The engines are supplied with a receiver and heater and exhaust into a Blake jet condenser drained by a vertical air pump which stands directly between the two. A partial view of the two-phase generators is shown in Fig. 6, and it will be noted that they are mounted on massive brick foundations, and are provided with outboard bearings.

The building is of brick having an iron frame and brick inwalls and is provided with two 20-ton cranes worked by hand-power. It will be when complete an extremely well ordered, well arranged station in every detail.

The Rubber Industry of Nicaragua.

Mr. Henry E. Low, United States Vice-Consul at Managua, Nicaragua, has forwarded to the State Department some interesting information regarding the rubber industry in that country.

A law has recently been passed prohibiting for a term of 10 years, from the 1st of January, 1897, the exportation of india rubber gathered in the national forests of the republic. India rubber can be

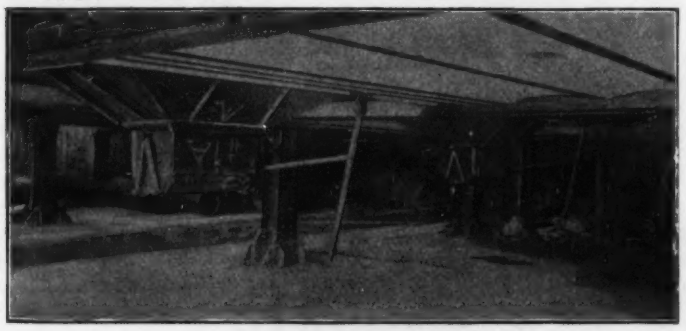


Fig. 3.—Ash Pits.

exported, however, when coming from regular plantations conducted in conformity with the bounty laws of 1883 and 1887. Any one who is found extracting rubber from the national forests will be fined and sentenced to imprisonment.

Between April 14, 1874, and July 1, 1896, omitting the years 1881–94, inclusive, the shipments of rubber to the United States from San Juan del Norte aggregated 6,388,303 pounds, and the total value of the same, including the years omitted in the statement of quantity, was $6,578,783.02. Much of the rubber shipped from San Juan del Norte comes from Costa Rica, which country contributed

Fig. 4.—Boilers.

between 35 and 60 per cent. of the total amount. The value of rubber shipped from San Juan del Norte to the United States for the year ended June 30, 1896, amounted to $134,584.25. It was invoiced at from 38½ to 52 cents.

A great deal of attention is being given to the cultivation of the india rubber tree along the Bluefields River. There are about 75,000 rubber plants on plantations on the Escondido which are vigorous and promising, and ready for transportation. In 10 or 12 years after these shall have been planted the banana industry will be of little importance.

Localities in Nicaragua south of latitude 15 degrees north and between longitude 84 degrees 10 minutes and 85 degrees 35 minutes, in low valleys where the soil is deep alluvial or deep vegetable

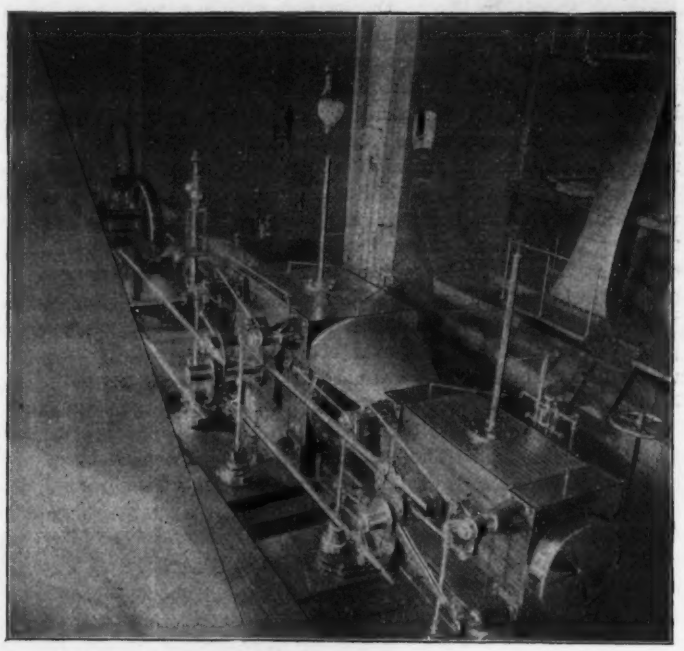


Fig. 5.—Horizontal Engine Driving Jack Shaft.

humus and sand and capable of being rapidly drained and in a climate that is almost uniformly warm and humid, suit the largest rubber-yielding varieties of trees and vines. Some varieties, however, giving an excellent quality of very elastic rubber are indigenous to a higher, dryer climate and soil.

The quantity of the annual yield of elastic material depends, the soil and climate being suitable, on the bulk of the bast or lactiferous tissues that exist or that can be developed in the tree or vine. Some trees of 2 to 3 feet diameter and 35 to 50 feet tall will give annually 20 to 40 pounds of good rubber.

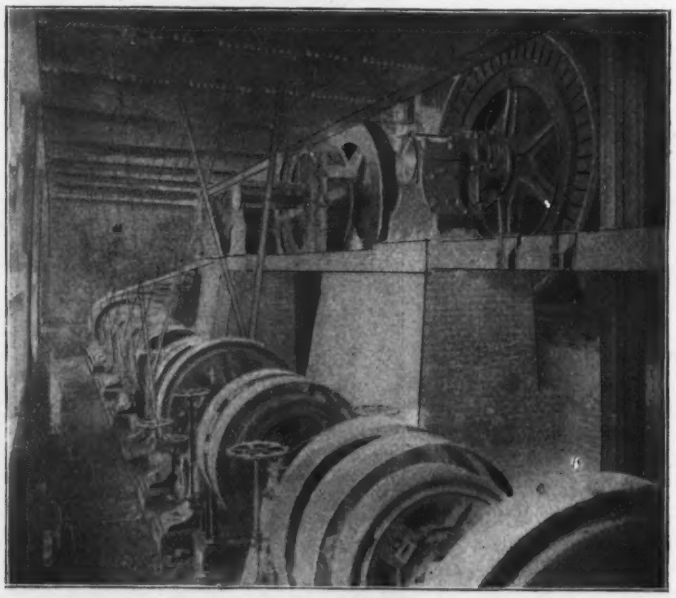


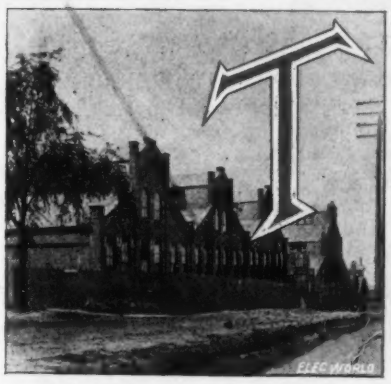
Fig. 6.—Jack Shaft and Two-Phase Generators.

Quality and quantity therefore are responsive to cultivation—to be increased or decreased.

The net profit from an acre in rubber trees, in Nicaragua, say, only 64 to each acre, 10 pounds each equals 640 pounds at 30 cents net per pound, $192.

Electrical Machinery of the Walker Company.—II.

(*Continued from page 425.*)



THE commutator is formed by copper bars, the lugs being riveted and soldered on. The bars are insulated with mica, and are held in place by a new and ingenious clutch shown in Fig. 16. The commutator bars rest in micanite rings supported on the spider. The inner surface of the spider is tapered so that by drawing up the outer rings with the bolts the bar is pressed firmly downward without injuring in the least the insulation. The crack between the bars and retaining ring is thoroughly filled to exclude dirt and moisture. The commutator spider is mounted on and keyed to the sleeve which forms a part of the armature spider, so that the armature and commutator may be removed together from the shaft and the commutator then removed from the armature. This arrangement is much to be desired, as distinguished from the method of keying both commutator and armature on the shaft independently. The shaft is of forged steel turned and shouldered as shown in the illustrations.

The Walker brush holder is of recent design. A flat piece of carbon with two beveled edges forms the brush, and is held against the flat, plain surface by a single finger. It adjusts itself to the commutator, and is tightly held against the flat surface of the holder, so that a splendid contact is formed between the brush holder, which prevents all undue heating. These are the secrets of excellence in the Walker commutator and brush holder. The current density is about 35 amperes per square inch of brush contact. The brush holder was illustrated in THE ELECTRICAL WORLD of May 30, 1896, page 649.

The bearings of the dynamo, which are self-aligning, are lined with genuine babbitt, holes being cast on the inner sides to secure the babbitt when it is poured in place. The babbitt is poured about a mandrel and then bored. Two rings supply oil for lubrication, either of which would serve in case of the failure of one. A small gauge shows the height of the oil in the oil well. On the direct connected generator there is but one bearing, called the outboard-bearing, the other being that of the engine. When connected direct to cross-compound engines there is no bearing whatever, the engine's bearings being sufficient. With small belted generators there are two bearings, while on the larger belted types the pulley has a bearing on either side which supports the shaft against the belt pull. The field has been so constructed that it is relatively very powerful in its magnetic effect as opposed to the armature reaction. This has resulted in producing a machine which runs sparklessly with but very little change of the brushes from no load to 75 per cent. overload.

The railway motors, as before stated, are constructed in six sizes and types. There is much greater opportunity for inventive ingenuity in a railway motor than in a generator. The severe service that it is required to withstand and the fact that it must be cheap, light, strong and durable, taxes the engineer's inventive ideas to the utmost. The Walker Company has produced a motor which ingeniously combines the good qualities of existing types with a number of special patented features, resulting in a most excellent machine. The field magnet, which also forms the outer casing, is of soft cast steel, has four poles and four coils and is therefore well balanced. In Fig. 18 a view of the motor-field is shown. By close inspection it will be seen that a single piece of brass serves to hold the end of the two coils in place by a single bolt, so that the four bolts secure the entire four coils. The bearings, as will be seen, are entirely outside the motor box, so that any grease exuding from them will drop to the ground and not reach the interior. The parts are all interchangeable, and may be ordered from the factory with the certainty that they will fit. In

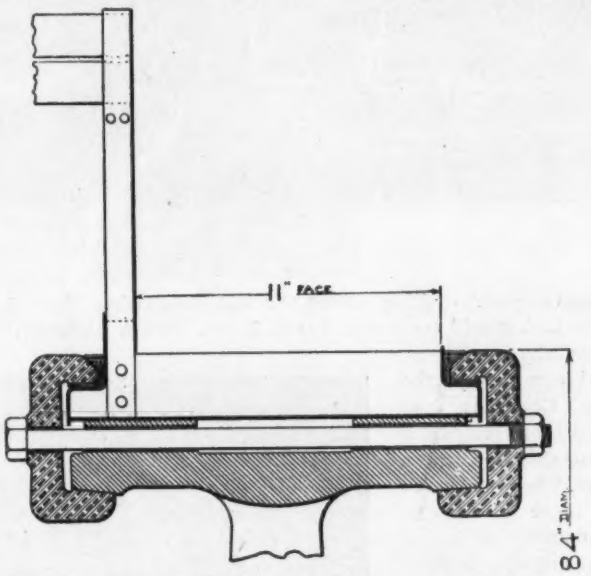


FIG. 16.—METHOD OF HOLDING COMMUTATOR SEGMENTS.

winding the field-coils a wooden former is placed in a lathe as shown in Fig. 20, and the wire is wound on and taped in such a way as to bind the coils tightly together. Flat terminals of copper are then soldered on to the ends of the wire and the whole coil taped, only the ends of the terminals protruding. The coil is then soaked in asphaltum several times until thoroughly waterproof. The armature-core is built up similarly to the dynamo-core, except that each lamination is a complete disc and keyed directly to the shaft. Saucer-shaped end discs are provided, as shown in Fig. 21, and the whole is set up with a powerful nut screwed on the shaft. The armature-discs are stamped out of sheet iron with a single stroke of a powerful die shown in Fig. 19. This press, of course, is used for punching other discs as well, but the core-discs of these armatures are all made with a single stroke. Slight grooves are turned in the armature surface in one or more places along the armature teeth, depending upon its length. The slots and end supports of the conductors are insulated in precisely the same way as are the generators, but on the motors the coils are all wave-wound, so that only two brushes may be used at right angles to each other for convenience in inspection and adjustment through the limited space afforded by the trap door in the top of the motor. On the small 25-hp motors wire is used for winding the coils. Fig. 20 shows the process. The coil is wound with a double-covered flexible wire on a former. Two sets of coils are placed together as shown in the middle of the figure and tightly taped in position as shown to the left of the same. All other sizes of machines are wound with flat ribbon in precisely the same way as the generators.

FIG. 17.—INSULATING DEPARTMENT.

Figs. 23 and 24 are good examples of the method of changing the voltage of a motor by simply changing the number of commutator bars. Both cores are precisely the same in every respect. The coils

are of the same size, but in Fig. 23, illustrating the 500-volt winding, there are many more commutator bars than are shown in Fig. 24, which latter is a storage battery motor designed to operate at about 125 volts. The coils are of the same shape and of the same size and number of conductors, but more are connected in multiple at the

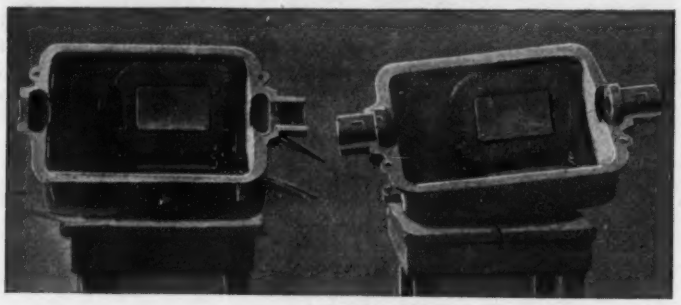


Fig. 18.—Field Pieces of Railway Motor.

commutator-bars. Fig. 24 shows the last coil being slipped into position, and it will be noted that it is not such a difficult matter as generally supposed.

The old armature of the Walker Company had spiral end connectors and is presumably of a design that could be constructed much more compactly than could the barrel windings shown in Figs. 23 and 24. It is a fact, however, that the barrel windings make the armature no longer than the old windings that pass over the ends of the core, and have all the superiority of uniform size, shape and resistance, perfect mechanical and electrical balance, and complete protection from the oil of the bearings. With the present facilities of the company it is possible to prepare in about a day a 500-volt armature complete and ready for soldering.

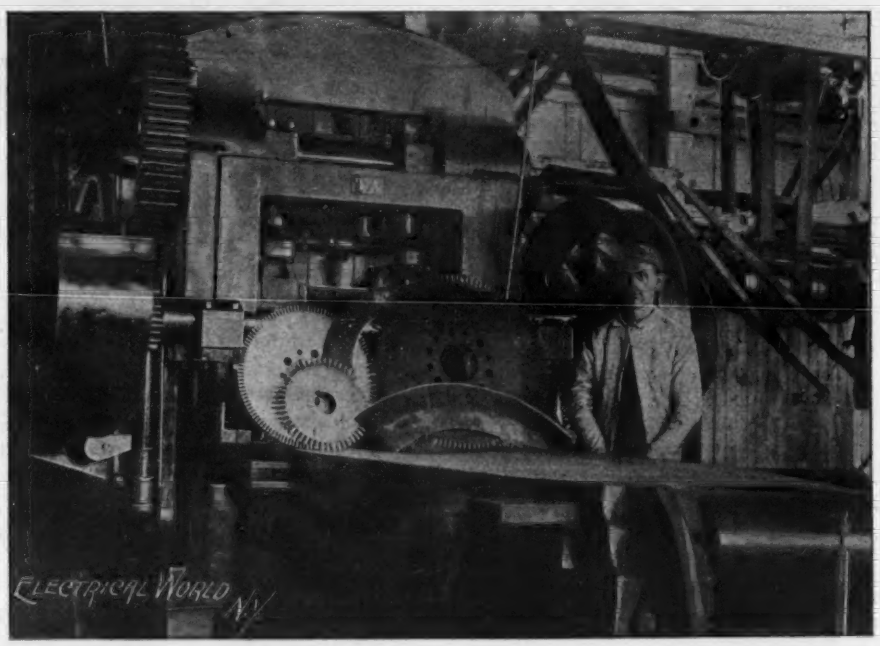


Fig. 19.—Press for Stamping Core Discs.

The commutator is constructed with great care. The bars are of drop forged copper, one of which may be seen in the foreground of Fig. 25. They are insulated from their sleeve with large mica rims, so that a current between the commutator and shaft would be obliged to pass over a surface of nearly two inches of mica. The

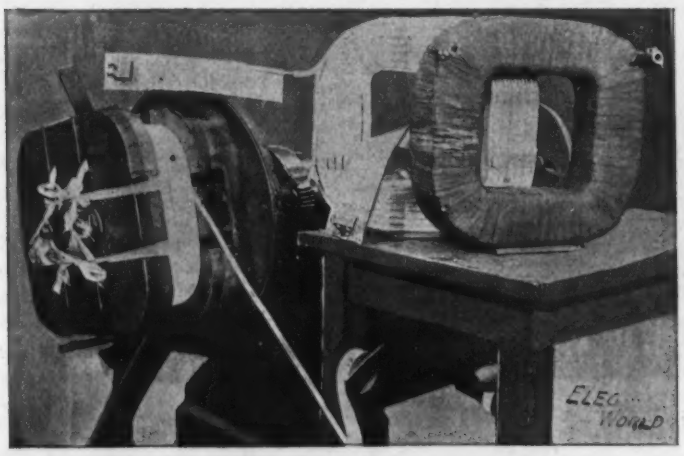


Fig. 20.—Winding Field Coils.

bars have a large depth, which insures a long life, fully equal to that of the machine on which they operate. In assembling them after the mica has been put in place, they are mounted in a powerful ring clamp, shown to the left in Fig. 25. The inner ring is split, and when pressed with set screws, produces a pressure on the commutator of several tons per square inch. The insulation of the commutator,

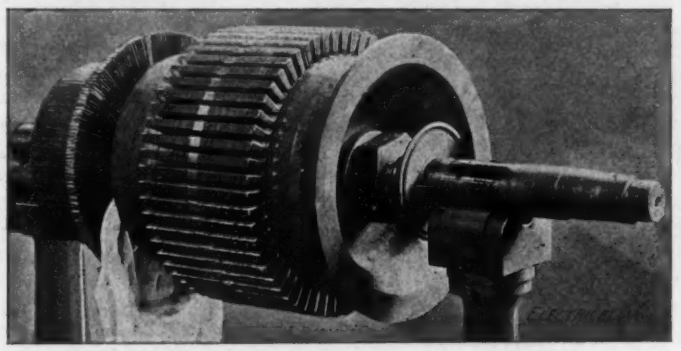


Fig. 21.—View Showing End Disc.

armature and field-magnet is tested to 5000 volts alternating-current. The commutator is located on the shaft of the motor, independently of the armature, and may be readily withdrawn from the armature shaft for renewal or repairs.

The Walker motor support is one of the exclusive features of the equipment, and with many railway managers is the convincing argument which decides them in placing their order. It is certainly a very effective device. A U-shaped frame is made, the arms of the U being fastened to the axles of the motor and on the lower part is a tube surrounding the car axle. This forms a space-bar, which rigidly preserves the relative position of the pinion and gears, but at the same time allows the motor to be free to move up and down. The motor is cushioned at the point of support in the customary manner, and also on the top of the axle. It cannot hammer on the

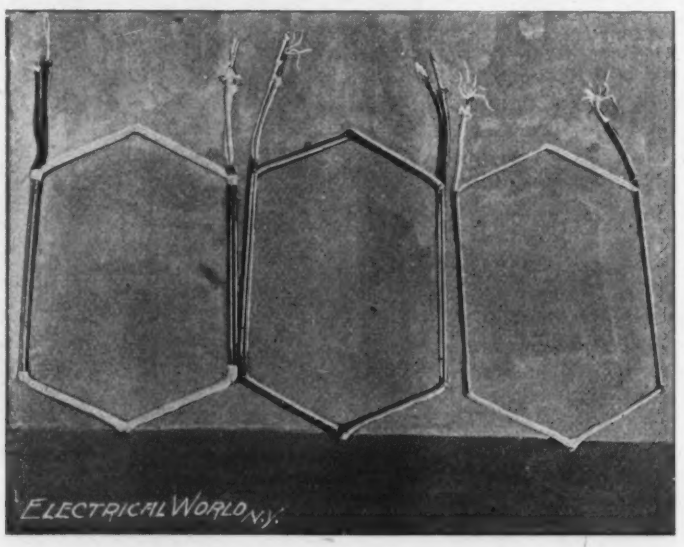


Fig. 22.—Armature Coils.

axle except through the medium of a spring, and therefore no more pounding is produced upon the track than by the wheels of the ordinary railway coach. The method of mounting is shown in Fig.

26. Another property which this method possesses is that the motor cannot at once transmit its energy to the car wheel; it must first compress the springs until their reactive effect is equal to the forward action of the motor, and therefore the suspension is very easy on the gears, which results in a uniform starting effort.

The controller shown in Fig. 28 has been previously described in our columns, but its features of manufacture were somewhat neglected in that description, which was confined more to its operation. As shown in the illustration, the contact-cylinder, the reversing-cylinder and the special switch-cylinder have been placed alongside the controller, so that their construction may be seen. All of these cylinders consist of a spindle insulated with a tube of suitable material, upon which are alternately slipped brass castings and rubber rings. The brass castings carry suitable lugs so as to make proper contacts, and are connected in groups in an appropriate manner. Wherever there is a large difference of potential between the castings, the intervening insulated collar is made exceptionally wide. The special switch-cylinder is shown with the castings which manipulate it, so that it may be readily seen that the cylinder is reversible and that as soon as one side of the contacts are worn the other side can be then used. The action of the controller is pretty well known and has been fully described in these columns. It may, however, be well to give a brief *résumé* of its action. The controller advances in the ordinary manner making the first combination, but upon the least motion toward the off position, a special switch is thrown breaking the circuit in 32 different places, thus breaking the arc into as many smaller arcs, all of which are perfectly harmless. From this position on the controller-cylinder has no current and must be brought back to the starting point before it can close the breaking-switch and pick up the current again. It is worthy of mention that when in action the 32 contacts are cut out and their resistance, often excessive, is thus eliminated. In Fig

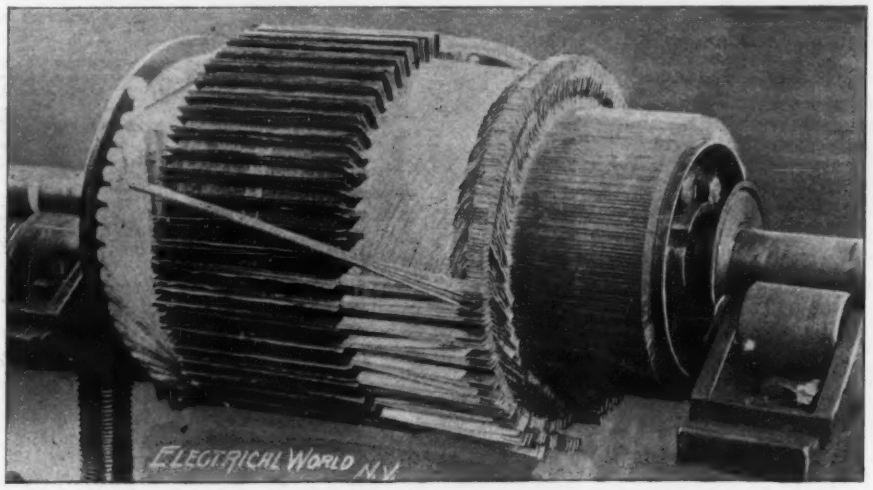


FIG. 23.—ARMATURE WINDING.

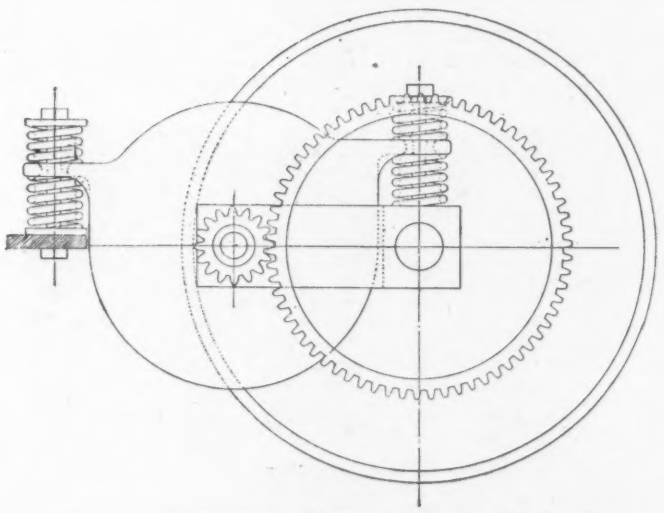


FIG. 26.—METHOD OF MOUNTING RAILWAY MOTOR.

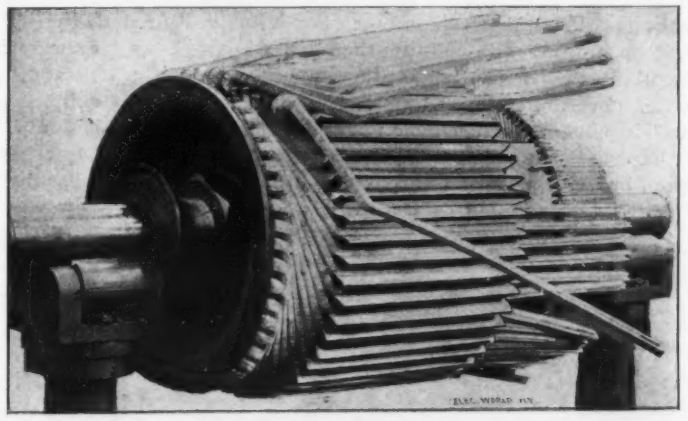


FIG. 24.—ARMATURE WINDING.

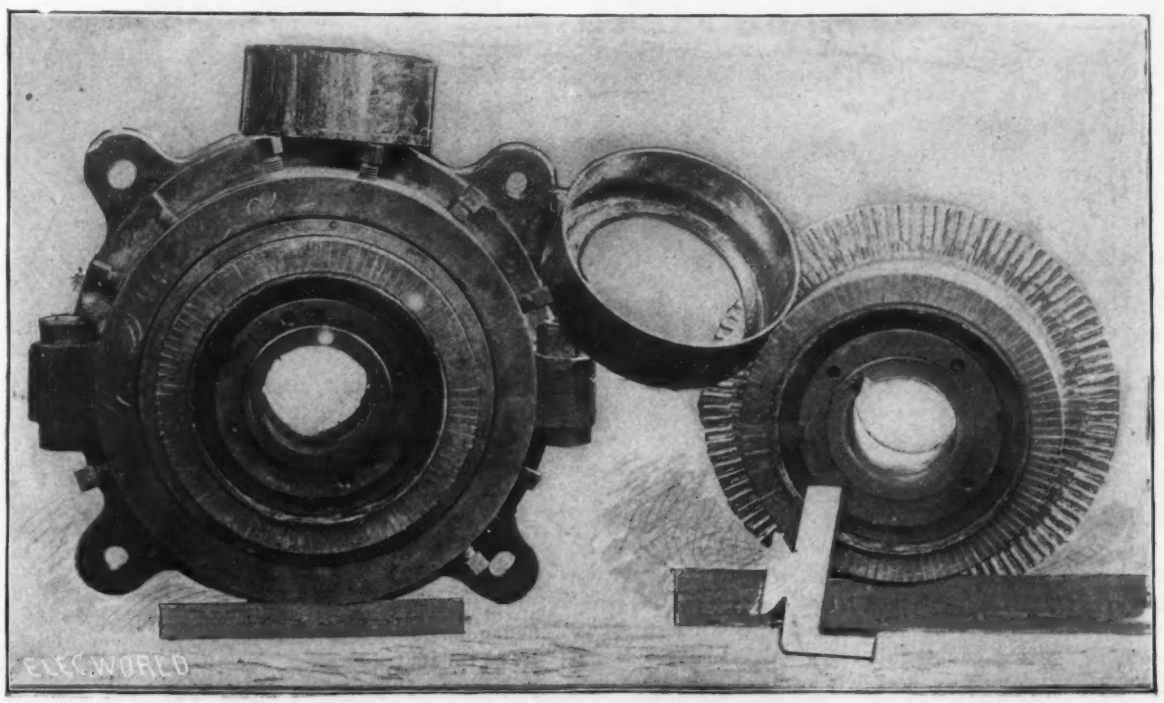


FIG. 25.—ASSEMBLED COMMUTATOR SEGMENTS.

28, the controller with the upper covering removed is shown. On the left is the reversing-spindle, in the centre the contact-spindle, and on the right the special switch-spindle, which is manipulated by the levers *D* and *X*. As the controller is turned, the lug *B* strikes the lever *D* and closes the break-switch. The knob *C* moves between two stops on the cover of the controller which limit the motion of the breaking-switch spindle. Having thus been thrown as described, the pawl *X* impinges on the teeth of the ratchel-pawl *A*, and as the wheel advances clicks over them. The least motion towards the off position will cause the pawl *X* to catch in the ratchet teeth and open the reversing switch, throwing off the current, so that the cylinder may be swung back to the off position without breaking any circuit, and hence without arcing. The lever *K* is simply a portion of the unlocking device which prevents the reversing switch from being thrown unless the controller spindle is in the off position.

The motor-starting resistance shown in Fig. 29 is ingenious because of its most effective, durable and compact construction and its cheapness to manufacture, which latter point, however, does not affect its desired aims. In order to produce an article cheaply it is necessary that it should be simple, strong and durable, and in this way the Walker Company has endeavored to produce all its machinery, but never has it allowed cheapness to come before good qualities. The resistance is composed of a number of cast-iron frames which are thoroughly insulated with asbestos. Upon them is mounted a flat strip of iron ribbon, with asbestos ribbon between and the ends suitably secured to the electric terminals. The coils are then banked in a pile and secured by two bolts, which also hold at the same time the end plates and the outer covering of the rheostat. The whole is fire-proof, simple and well insulated, and not liable to get out of order.

Fig. 32 shows the new Walker trolley, of which much has been said, but which should not be omitted in this article. It has been

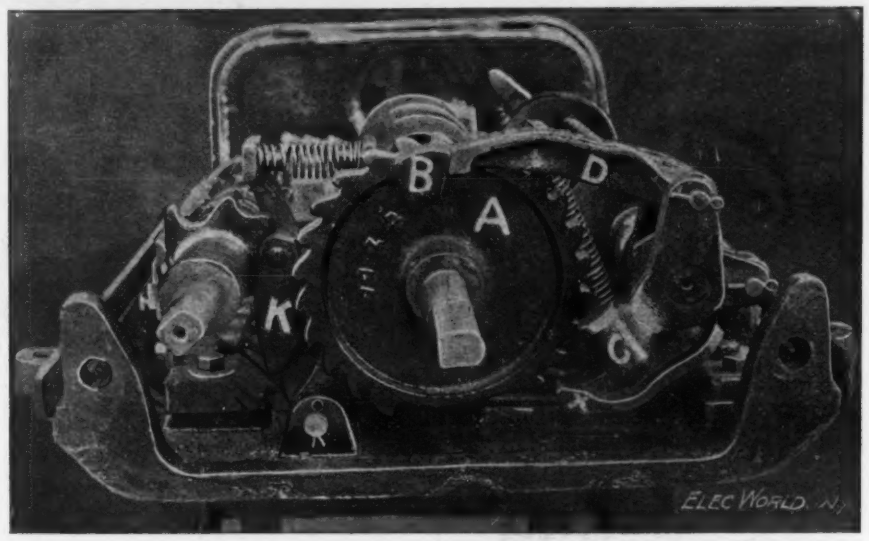


Fig. 28.—Top View of Controller.

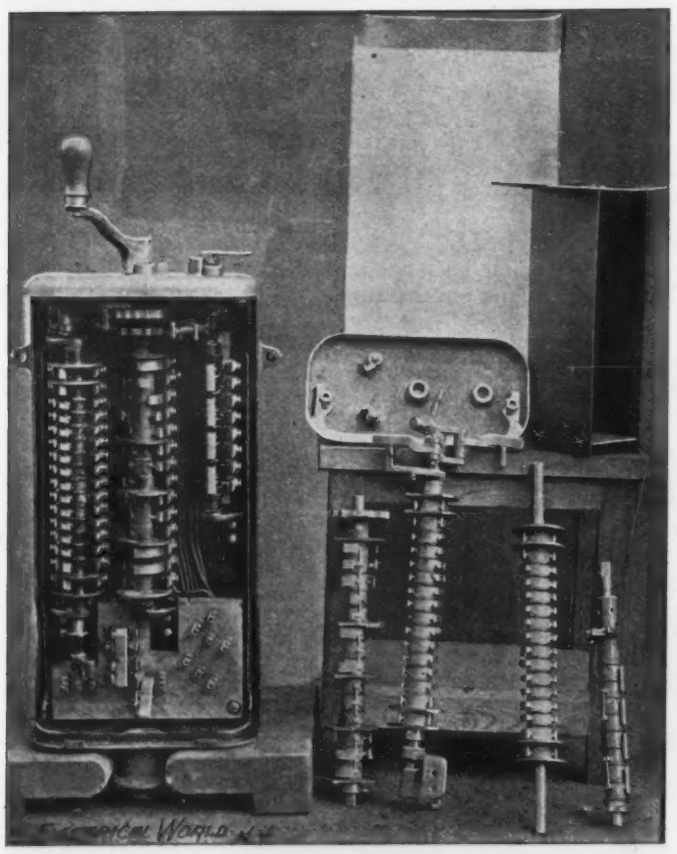


Fig. 27.—Interior of Controller.

argued that it appears ungainly on the roof of a car, but upon looking at the illustration it cannot be said that this will constitute a serious objection. It looks odd, that is true, but that is because the public has become accustomed to another type. The pneumatic tire used upon bicycles was a decided oddity in the days of solid tires, but now the reverse is the case. It is only a matter of convention. The merit of the trolley is its safety, inasmuch as it cannot leave the wire, and the great facility with which it may be used upon a car running either forward or backward. It has ball-bearings, needs no oil, and inasmuch as it has no lateral motion, it is claimed does not infringe upon the Van Depoele patent. It has already caused con-

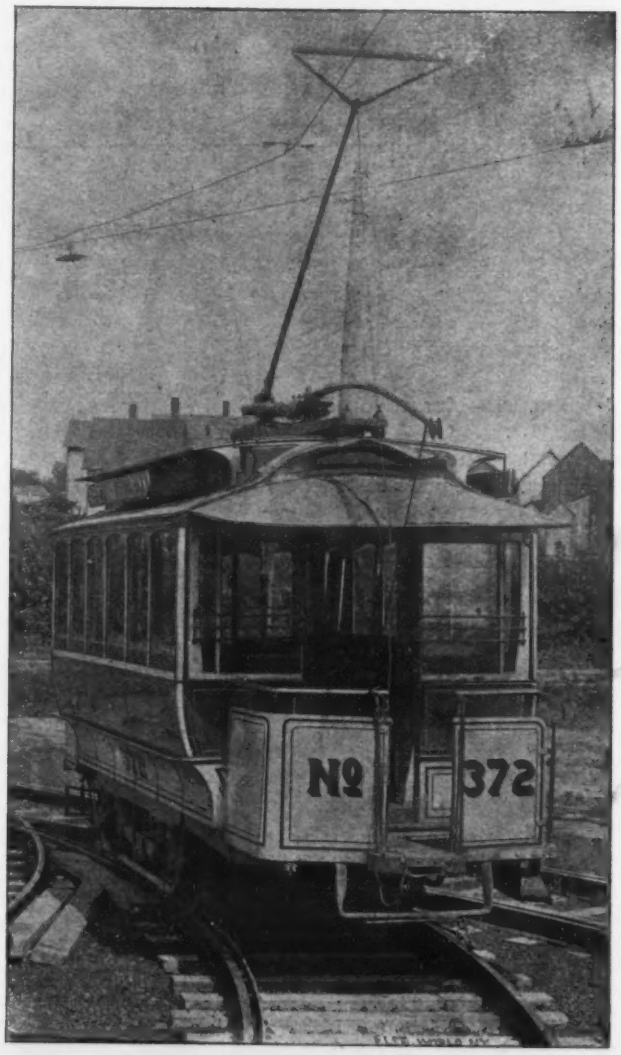


Fig. 32.—Walker Trolley.

siderable comment, and is likely to find favor with electric railway managers.

The isolated plant generators for direct-current lighting have been quite thoroughly described in describing the railway generators, the

difference merely being in the details of the winding. We present, however, in Figs. 30 and 31 illustrations of dynamos for this service, of which Fig. 30 shows a belted type. It is a shapely symmetrical machine and thoroughly well designed, both electrically and mechanically. The direct-connected unit is, however, a newer product and

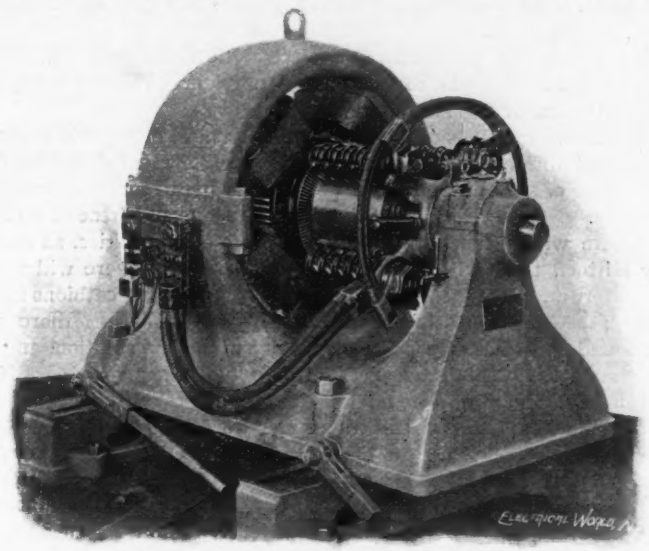


FIG. 30—BELTED LIGHTING GENERATOR.

has all the attributes of the newest Walker generator. The ring brush support enables the commutator to be free, and admits of the ready removal of the outboard bearings without disturbing anything else, a feature which in isolated plants especially, engineers will readily appreciate. It can be connected to any standard engine.

The Walker Company has pursued the policy that the day of mysteries surrounding dynamo-electric machinery has passed, and that it is now impossible to deceive purchasers into paying enormous prices for manufactured iron and copper. Dynamos have been built for so many years that only patents relating to details can be obtained upon them, so that any one is at liberty to build a machine in almost any form that he desires. Having these privileges the Walker Company has selected the types which appeared to it best among the

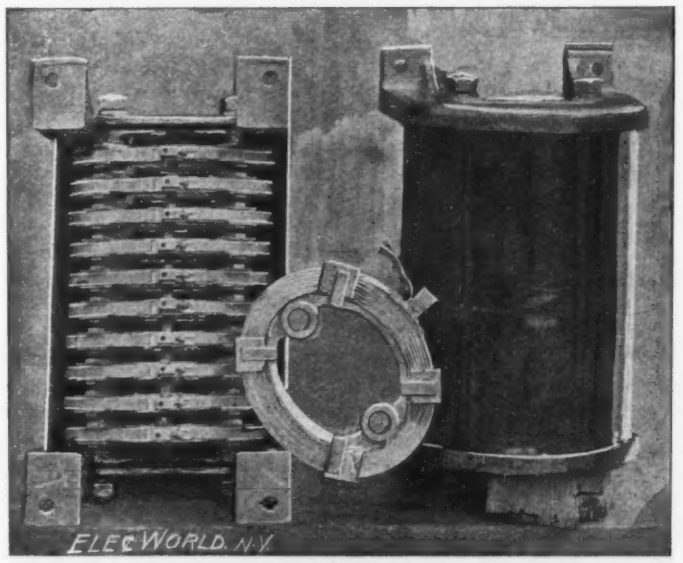


FIG. 29.—STARTING RESISTANCE.

results of the long experience of its engineers. Combining these with its ingenious and numerous detail patents, it has succeeded in producing a machine which challenges the world.

To Extend the Schenectady Plant.

It is reported that the General Electric Company contemplates the erection of two new buildings at its Schenectady plant, and that some of the business now carried on at Lynn, Mass., will be transferred to Schenectady on the completion of the new improvements.

American Electro-Therapeutic Association.

EXTRACT OF REPORT OF THE COMMITTEE ON DIRECT OR CONSTANT GENERATORS AND CONTROLLERS.

The members of the committee have continued, during the year, to examine and test such apparatus as furnish a suitable constant-current for physicians' uses, and also such appliances as are devised for modifying this current to meet the requirement of practice.

The direct-current is used in practice to effect electrolysis of tissue; to do cataphoric work; to excite or modify physiological action; to modify nutrition; to light exploring lights, and to heat cauteries.

The committee has sought to determine the most convenient and effective sources of constant-current to meet the requirements of practice in these particulars.

For a Stationary Source.—Such as would be suitable for offices, hospitals and dispensaries—the most convenient and economical of all sources is the dynamo.

Of these the Edison dynamo for incandescent lighting with E. M. F. of 110 volts.

Various direct-current dynamos used for running street cars, distributing power, etc., with the E. M. F. of 500 volts.

Motor dynamos of special design, converting alternating currents into undirectional currents and constructed to furnish any desired voltage, are at present in many places available. The current from any one of these sources when it is at hand can supply the needs of the electro-therapeutist for a direct current, provided he makes use of a current controller to modify and adopt it to the cases to be treated.

If the dynamo source of current is not available the next best source of constant current is a plant of ammonium chloride cells with zinc and carbon elements and a good depolarizing substance. Our experiments have shown that the cells of the Leclanche, the Laclede, the Law or the Fitch perfect type answer very well for this purpose. Fifty of such cells connected in series furnish a current with an E. M. F. of about 70 volts. The current from this source can be best modified to suit the case by means of a graphite rheostat such as the Massey, McIntosh or that of the Chloride of Silver Company.

For a portable battery for direct-current work, where the apparatus must go to the patient instead of the patient to the apparatus, great power compared with compactness and durability are the main requirements. In these particulars the direct-current portable battery manufactured by the Chloride of Silver Dry Cell Battery Company, of Baltimore, was recommended. Fifty cells of one of these batteries can be enclosed in a box of convenient size together

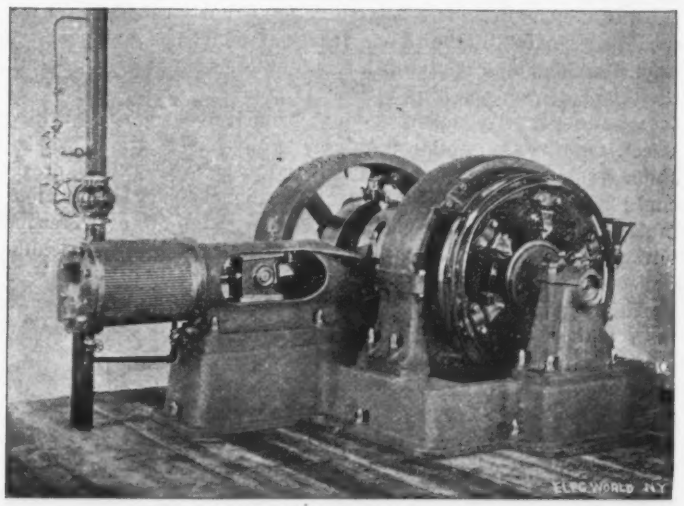


FIG. 31.—DIRECT CONNECTED LIGHTING UNIT.

with a milli-ammeter and graphite rheostat, thus making a complete outfit.

The E. M. F. of the current from fifty of these cells in a fresh state is about 45 volts. The advantages of the dry cell for use in a portable battery is self evident and the main advantage the chloride of silver cell has is that of its size—its diminutive proportions permitting a large number to be put into small space. This one feature aside, many other dry cells, like the Vetter for example, act equally well. The greater cost of the chloride of silver cell as compared with the others does much to offset with the purchasers the advantages arising from its small size.

Electrolysis and Some Problems in Molecular Physics.

BY C. L. MEES.

(*Continued from page 350.*)

According to the state of aggregation of the dissolved substance before solution, energy changes usually become apparent either in temperature changes, contraction of the volume, or the like. As a rule such energy changes occur in the same sense when solutions of different concentrations are mixed, until a point is reached, with very dilute solutions, when they no longer are observable. The substance in the solution is then very small in amount as compared with the solvent. It is a well-known fact that when solutions of different concentration are carefully superposed the molecules of the dissolved substance pass from the more dilute solution, until finally a uniform degree of concentration is attained, when a condition of kinetic equilibrium is maintained. This diffusion phenomenon in liquids is similar to that in gases, only it progresses much slower.

In the case of gases the dynamics of the process is pretty well understood and satisfactorily explained by the kinetic theory, the mixture of the gases resulting from the projectile energy of the molecules. In the case of liquids it has been variously explained ; in general however the molecular attraction between the solvent and the dissolved substance has been assumed as the cause. Vant Hoff has recently offered an explanation along the same kinetic line so satisfactorily applied in gases. The force tending to produce diffusion must be measurable as a pressure if it exists. If then the two solutions are separated by a semi-permeable membrane which will allow but one of the two constituents to pass, this pressure will become measurable upon the membrane. The production of such septa is a matter of very great difficulty, but has been accomplished to a very perfect degree for some substances. The general method of making such measurements is familiar to all physicists. Traube Pfeffer, DeVries, Tamman and Pringsheim, from 1867 to 1885, have succeeded in producing semi-permeable membranes of great perfection, and with improved apparatus have made many measurements of very satisfactory character. These results show that equimolecular solutions of non-electrolytes have an equal osmotic pressure. The osmotic pressure is directly proportional to concentration (expressed in gramme equivalents).

The osmotic pressure is proportional to the absolute temperature. The similarity of these laws to those of gaseous pressure is at once apparent. Vant Hoff further, upon the basis of absolute measurements and the application of the ordinary equations for properties of gases, enunciates the law, that the molecules of the dissolved substance exert pressure. Osmotic action equal to the pressure which would be exerted by the same number of molecules in gaseous state upon the sides of a containing vessel of the volume of the solution, the temperature remaining the same.

Osmotic pressure seems then to be merely a molecular kinetic effect. On this assumption thermodynamic considerations lead to the same result as experiment. The first two laws of osmotic pressure could be satisfactorily explained under the ordinary supposition of molecular attraction; the last two however are different to reconcile with any explanation other than the one that the pressure is due to molecular impact.

The osmotic pressure of electrolytes is considerably greater than than that of non-electrolytes; in dilute solutions they, however, follow the same laws of variation.

Blagden, as early as 1788, recognized that salts in solution lowered the freezing point of water. Riedorf, Coppett and Raoult carefully studied the subject and found that the molecular depression of the freezing point was equal for salts of similar composition. For non-electrolytes, solutions of different salts gave very nearly the same values, showing that the effect was purely a molecular one, independent of the nature of the substance.

The problem may be treated from the dynamical point of view upon this supposition; knowing the osmotic pressure and imagining the change in state in the nature of a reversible cycle, the necessary energy changes are calculable. The depression of the freezing point calculated in this way for a number of substances, gave values closely agreeing with experiment.

The evidence that this effect is purely a molecular kinetic process is very strong.

Electrolytes cause a depression of the freezing point, experimentally determined, far greater than non-electrolytes, thus having here another evidence of dissociation by solution.

The investigation of the effect of substances in solution upon vapor pressure and boiling-point made by Bertholet, Beckmann, Raoult, Ciamician, Ostwald and others lead to precisely similar laws.

We may summarize these laws thus; Equimolecular solutions of different substances made with equal masses of the same solvent show equal osmotic pressure, equal relative diminution of vapor pressure, equal elevation of boiling point and equal depression of the freezing point.

Reversing the phenomena of electrolytic decomposition, Nernst applies these concepts to the battery problem. We will apply the theory to one or two simple cases only.

When two solutions of the same electrolyte are brought in contact, electrical differences manifest themselves. The mere statement that the cause of such difference in potential is due to contact is unsatisfactory. Nernst reasons in this wise: The ions, in virtue of osmotic pressure will diffuse, migrating with different velocities, as shown by Hittorf, they will diffuse at different rates. There will result therefore an excess of anions in the one solution and cathions in the other; the ions possessing characteristic electric charges there will be found an excess of positive electricity in the one solution, and an accumulation of negative electricity in the other solution. If an indifferent electrode be immersed in each solution, connected through a conducting circuit, there must result a current. We have here a battery giving an electrical current as a result of osmotic pressure. The necessary conditions for the production of the current are that the ions have different velocities and exert osmotic pressure; that the energy associated, if current flows, is less at the close of the operation than at the beginning.

It would perhaps be expected from the above that the current would continue until the concentration had become uniform. Such, however, will not be the case in the battery just described, for the cathions at the cathode and anions at the anode will now develop electrostatic attractions which cannot be overcome by the E. M. F. of the battery.

Modifying the cell so that in place of indifferent electrodes we use electrodes of the metal, the salt solutions of which surround it, a battery results which will continue in operation until uniform concentration results. In this case the cathions will, at the cathode, by giving up their electric charges, become metallic, the electrode becoming positively charged ; at the anode metallic particles will go into solution as cathions ; this ionization involves energy, changes the cathions there produced carrying positive charges with them, leave the electrode negatively charged.

In a battery such as described, three differences of potential result, one at the surfaces of the solutions, which differ in concentration, and a difference of potential between the surfaces of the electrodes and the solution, the first having been explained as originating from osmotic pressure. Nernst explains the latter as resulting from a solution pressure. Just as a liquid evaporates from the surface until the vapor pressure becomes equal to the vaporization tension, so in solution will a salt dissolve until the osmotic pressure becomes equal to the solution tension of the salt. In the same way Nernst supposes that each metal has a tendency to convert atoms of the metal into ions in solution as soon as it is immersed in an electrolyte; this has been termed electrolytic solution tension. Osmotic pressure and solution tension thus become analogous concepts.

Three conditions are possible :

First: If the solution tension be greater than the osmotic pressure, the metallic plate acts like salt mass in a dilute solution. Cathions will be thrown into the solution positively charged, leaving an equal negative charge upon the electrode at the surface of the separation; between solution and electrode we will have positive cathions upon one side and negatively-charged metal upon the other, these exerting electrical forces, a condition will be reached when they are equal to the solution tension; further action will then cease until the cathions are discharged or made metallic.

Second: If the osmotic and solution pressures are equal no difference in potential will result, as when a mass of salt is introduced into a saturated solution of itself no change takes place in equilibrium.

Third: When the osmotic pressure is greater than the solution cathions will be projected upon the plate and made metallic, the electrode becoming positively charged and the solution negatively, similar to the action which takes plan when a solid salt is brought in contact with a supersaturated solution, when salt particles will be deposited.

The determination of the relative values of solution pressures is comparatively simple, the determination of their absolute values very difficult. In the case of mercury and a saturated solution of

calcium chloride, the absolute value has been determined with considerable accuracy from the effect upon tension phenomena in a mercury surface, fully discussed by Lippman, Helmholtz and Paschen. Ostwald and Planck obtained values by two methods based upon this action, agreeing very well. With this value as a basis, others have been determined. Applying these values experimently obtained, together with the ones for osmotic pressure, in calculating the E. M. F. of a number of well-known cells an excellent agreement with experimentally determined values is found.

The development of the solution and dissociation theories gives no explanation of the forces and conditions which cause solution or ionization, though some attempts have been made in this direction. J. J. Thompson has shown that if the attraction between the ions in the molecule is due to electrical forces it will be weakened if the molecules be immersed in a medium of high specific inductive capacity. Experimental evidence, in so far as it goes, shows that in liquids of high specific inductive capacity, ionization is most complete. This is one of the problems to be systematically studied.

Since Willard Gibb's theoretical work bearing upon this subject, scarce a single addition of importance has come from American workers; in fact, it seems that much of the work done abroad is scarcely known to American physicists. It is to be regretted that in the history of the development of this branch of electrical science hardly an American name will appear.

Whether electrolytic action ever occurs in solids is a question which I do not believe has been definitely settled. If such action ever does take place the theories just considered will have to be modified. Some very curious phenomena in glass subjected to the action of the electric currents have been noticed; the claim has been made that glass has actually been electrolyzed, though the evidence so far is not conclusive. The very interesting changes of conductivity, with variation in temperature, exhaustively studied by Thomas Grey, indicate molecular changes which may be due to dissociation. The form of the equation for change in conductivity with temperature shows a maximum with reversal, considerably below the fusing point. A similar peculiarity is noticed in alloys. The systematic study of this seems important.

Careful study of heat absorption when salts are dissolved should be made. Much work has been done in this direction. A careful examination and comparison of results, however, convinces one that the methods and manner of conducting the investigations must have been widely different, for the results vary in a most astonishing manner; at any rate, definite conclusions cannot be based upon them. If ionization requires energy it is more than likely that some will be taken from the solution in the form of heat. In very dilute solutions dissociation of the electrolyte seems incomplete, while in concentrated solutions it is incomplete. A careful determination of the heat absorption per molecule when the salt is dissolved in concentrated or dilute solutions might give valuable results. The problem is very complicated, yet should be attacked.

That gases cannot conduct electrolytically seems fairly certain. This field is scarcely entered, and may well be studied.

The peculiar behavior of charged plates under the influence of violet light seems likely to involve electrolytic action and bear upon dissociation questions.

So multitudes of problems suggest themselves, the study of which may tend to crystallize the theories of dissociation and solution, so promising at this time, into a more perfect form. It can scarce be doubted that the remarkable connection evident when the phenomena of solution, modification of freezing and boiling point, osmotic pressure, optical rotation, chemical equilibrium and stability-metathetical reaction, thermal neutrality, electrical conductivity and electrolysis are considered, taking the molecular equivalent mass as the unit indicates a very near relationship of these processes.

The power of the Arrhenius dissociation theory, Vant Hoff's solution theory, together with the connections of Hittorf, Clausius, Nernst and Ostwald in explaining the dynamics of molecular action is most promising. Whether more accurate and more plentiful quantitative studies of these so closely related phenomena will lead to closer concordance or greater divergence of the numerical values obtained, thus strengthening or weakening the theories, must remain to be seen.

These theories, if fastened, will have a marked influence both upon the chemical and physical conceptions of the structure of complex molecules. They seem to demand essentially a condition of kinetic equilibrium between molecules and atoms; inter-atomic distances we will have to consider greater than was our wont—atomic and molecular influences must extend to considerable distances. Geometrical static arrangements of atoms or groups of atoms seems incompatible with their behavior.

The relation of atoms in the molecule seems to be orbital, permitting of ready arrangement and readjustment by relatively slight disturbing causes, capable of returning to former relations promptly, involving various quantities of energy.

All of our inferences in reference to molecular magnitudes will have to be interpreted as effective merely and not actual, in the sense of space occupied.

The one central pillar upon and about which all physical science is erected to-day, the conservation of energy, stands unchanged, and, if possible, more clearly defined and strengthened than ever.

I repeat, may American physicists take up these problems and add their share to the development of these epoch-making theories.

Present Status of the Distribution and Transmission of Electrical Energy.*

BY LOUIS DUNCAN.

(*Continued from page 430.*)

CONTINUOUS-CURRENT TRANSMISSION.

The first long-distance transmission plant was operated by the continuous-current system, and even now plants are being built in which continuous-currents of high potential are used to transmit energy to distances up to 15 miles. As compared with transmission by means of alternating-currents, we will find that the continuous-current system possesses some advantages and some disadvantages. If we consider the relative cost of the copper in the line for a given amount of power transmitted and for a given maximum potential between the conductors, we will find that the relative amounts for the continuous-current and the different alternating-current systems, will be as follows:

Continuous-Current	100
Single-phase Alternating	200
Two-phase "	200
Three-phase "	150

We see then that the continuous-current has a marked advantage over the alternating-current systems as far as the cost of copper is concerned. There are, however, certain practical disadvantages belonging to this system. The high voltages necessary for long-distance transmission make it impossible to distribute the current at the receiving end without first reducing the voltage. With continuous current this can only be done by employing a rotary commutator of some kind. A plan which has been practically and successfully used has been to run a number of dynamos in series at the generating end of a line, while at the receiving end are a number of motors, also arranged in series, which are used to drive other generators to give the required type of current and the desired voltage. It has not been found possible to make either dynamos or motors of any great output, as there are practical difficulties in running dynamos of high potential where the current taken from them has a considerable value. M. Thury has installed a number of continuous-current transmission plants that have apparently given excellent results. At Biberist a transmission of 15 miles is employed. At Brescia 700 horse-power are transmitted over 12 miles at a maximum of 15,000 volts. M. Thury states that generators for 45 amperes can be constructed up to 3000 volts, and he thinks that 4000 could be successfully used. These machines, however, are small when compared with the 5000 horse-power dynamos in use at Niagara, for instance, and where the transmission is a large one the great number of machines necessary would be a serious objection to this type of transmission.

It will be seen that the greatest possibility of trouble, in such a transmission, lies at the ends of the line, in the generating and receiving apparatus. It is necessary, no matter what our voltage is, that both the dynamos and motors shall be directly subjected to it, and this with commutated machines will always be a source of danger. If we are to do any considerable amount of lighting from such a station, our energy for this purpose undergoes three transformations before it reaches the lamps, and the efficiency would not be so high as in a corresponding alternating-current system. It would hardly be possible to supply motors for ordinary work at the high voltages used for transmission, and the current for them would have to be transformed in the same manner as the current for the lamps. It must be recognized, however, that this system has been successfully used and has given excellent results in a few cases of transmission. Its great advantage lies in the decreased amount of copper as compared with the alternating systems,

and in the absence of induction effects, which are a drawback to alternating-current transmission.

TRANSMISSION BY ALTERNATING CURRENTS.

A large proportion of the transmission plants that have been installed in the last few years have been of the alternating-current type. These have, as a rule, given satisfactory results, and the installations that are now being erected or planned are almost exclusively on an alternating-current basis. The great advantage of this system lies in the fact that it is possible to change the voltage of the current without the use of rotating apparatus, and at once economically and safely. Low-voltage dynamos may be used, the voltage may be increased to any desired ratio by stationary transformers, the energy may be transmitted at an increased voltage and at the receiving end the voltage may again be reduced by transformers. If we compare this method with the continuous-current system, we will see that to obtain an alternating current of the required pressure at the receiving end of the line we would use the same number of transformations required by the continuous-current system. We have the great advantage, however, that our changes in voltage have been obtained by the agency of stationary apparatus, which is much cheaper, is more efficient and is safer than that required in the continuous-current system. It is possible to increase the voltage by means of transformers to almost any value with perfect safety and with an efficiency as high as 98 per cent. or 99 per cent. If then our alternating current, when it has been reduced at the receiving end, is as valuable for distribution as the current obtained by the direct-current system, there will be no doubt that alternating transmission has great advantages over continuous currents.

I have spoken of the relative amounts of copper required by the single-phrase, two-phase and three-phase alternating currents. I do not think it necessary to explain minutely the difference between these systems, as they are well understood. In a single-phase system a single alternating current is used. In a two-phase system two alternating currents, whose phases differ by 90 degrees, are employed, while in the three-phase system there are three currents differing in phases by 60 degrees. I shall consider the characteristics of these three systems, as there has been much discussion especially as to the relative value of the last two of them for transmission work. I shall not discuss the various modifications of the systems, but shall confine myself to general considerations. There is no single-phase motor in successful commercial operation that does not require to be started from rest by some outside means. This prevents a single-phase current from being used at the present time for power distribution ; and as, in most transmission, the distribution of power is an important item, single-phase currents are not suitable for this purpose. In a two-phase system the currents are usually carried on separate pairs of wires, while in the three-phase system, three wires are generally used, a common return being unnecessary, as the sum of the currents is zero, unless the circuits are unbalanced. In distributing on the three-phase system, a fourth wire can be employed, as it gives an advantage in the amount of copper used.

In all these alternating systems the great difficulty lies in the fact that the inductance of the circuit causes the current to lag behind the E. M. F. This decreases the amount of energy transmitted by a given current at a given voltage ; it causes a drop in the voltage of the line, and it increases the armature reaction of the dynamo for a given current. The total inductance of the circuit is made up of the inductance of the transformers, of the dynamos, of the receiving apparatus and of the line. In the case of transmission to very long distances the line inductance is a large proportion of the total, while the inductance of the receiving apparatus depends upon whether lights or motors are to be supplied and upon the construction of the latter. When the different wires of the multiphase system are fed from windings on the same dynamo armature, then the drop in voltage due to any excess of load on one of these circuits cannot be compensated for on the dynamo itself. If the amount of current and the lag of the current is the same for all of the circuits of the system, then it is easy by a compound winding of the dynamo, or by changing the current in the field winding, if there is no compounding, to keep the voltage constant at either the sending or receiving end. When the load on the different wires of the system is not the same, however, it is, as I have stated, impossible to keep all of the circuits at the proper voltage. When a two-phase transmission with separate circuits is used, then if the separate circuits are wound on different armatures, each can be regulated to give a constant voltage at the receiving end. This is the case, for instance, in the large dynamos built by the Westinghouse Company for use at the World's Fair in Chicago. The difficulty due to the uneven loading of the circuits is specially marked in the case of the three-phase system, and it is one of the principal objections that have been urged against the employment of this system for distribution. It should be pointed out, too, that it is not enough to balance the qualities of current for the three branches of the system, but the character of the current must also be considered. A non-inductive load on one wire with an inductive load of equal value on the others would cause an unbalancing just as if the currents differed in amount. In most of the transmission plants that are being operated and that are proposed it is required to run both lamps and motors from the same circuits, and while a slight variation of potential on the motors would not cause any particular trouble, yet the successful operation of the lamps requires a practically constant voltage. I think, however, and the same grounds have been taken by others, that in any practical transmission of considerable size, it is possible to so balance the loads that this difficulty will not exist to an extent to cause any serious trouble. When the distributing part of the lines is reached it is usually the custom when a three-phase transmission is used to employ four instead of three wires. As for line inductance in the two-phase and three-phase systems, there is no question that the latter has an advantage in this respect, By suitable arrangement of circuits the line inductance can be brought to a minimum, and this is of the utmost importance in long-distance transmission. I will not take into account the supposed increased efficiency of three-phase motors and dynamos as against two-phase apparatus, as there is a question as to whether a superiority exists, but simply considering the decreased amount of copper required and the decreased inductance of the line, there is no question, in my mind, that for transmission the three-phase system is superior to the two-phase. It is well known, of course, that the inductance of the circuit can be, in some measure, compensated for by the use of condensers or over-excited synchronous motors. The first of these remedies is, however, a very uncertain quantity commercially, while the second should be used as much as possible, that is, as many synchronous motors should be connected as is practicable. The best remedy, as things stand at present, lies in the careful construction of the line and the apparatus, so that the effects, although they exist, can be reduced to a minimum.

It has been shown by Mr. Scott and others that it is possible to transform a two-phase into a three-phase current, to transmit it and to transform it back again to a two-phase current. This will allow us, if we wish, to use two-phase dynamos for generating the current, to transmit with the advantage incidental to the use of three-phases, and at our reducing end to use two-phase circuits for transmission. This has some advantage as far as balancing the voltage on the circuits go, and it has been proposed in the case of several plants whose installation is being considered.

Looking broadly at the value of alternating transmission as against continuous-current transmission, we have a gain in the simplicity and safety in the transmission, and at the distributing end the use of multi-phase currents enables us to supply both lamps and power with an economy and success comparable to that of the continuous-current system. If it is necessary to use continuous currents for certain types of distribution at the receiving end, they can be obtained by the use of rotary transformers, by which the alternating current is transformed into a continuous-current. These machines have approximately the efficiency of corresponding continuous-current dynamos, while the output for a given size is about 50 per cent. greater.

POSSIBLE VOLTAGES AND DISTANCES OF TRANSMISSION.

A number of calculations have been made as to the possibility of transmitting electrical energy to very long distances. If the question of cost of transmission alone is considered, then where water-power or culm heaps are within distances of 100 miles of some large centre of consumption, it has been shown that it would be profitable to generate and transmit electrical energy. In these calculations, however, voltages are assumed that have never been employed for commercial plants and whose availability is problematic, while sufficient stress is not apparently laid on the question of the reliability of the power. If the industries of a large city depended upon a single transmission plant it is evident that the question of reliability is of paramount importance. Where energy is supplied to manufacturers, to street car systems and for lighting, a breakdown that would involve the cutting-off of current for a day would mean an enormous pecuniary loss to the community. As the distance of transmission

increases, the possibility of accident is increased in greater ratio because we have not only the higher voltages to control but the length of the line that must be looked out for is also increased. The best guide lies in the practical experience which has been obtained in the present transmission plants and the consideration of the difficulties that have arisen and the remedies that have been employed. I have prepared a partial list of the principal transmission plants that are now in operation:

Name.	Type.	Distance in Miles.	Line Voltage.	Horse Power.	Remarks.
Ouray, Col	Direct.	4	800	1200	Successful, increasing
Geneva, Switzerland	"	20	6600	400	Successful.
San Francisco, Cal	"	12	8000	1000	Successful, 9 years.
Brescia	"	12	15,000	700	
Pomona and San Bernardino	Single phase Alt.	13½ to 28¾	1000	800	Suc'l, increas'g, 4 yrs.
Telluride, Col	"	3	3000	400	To be increased 3200 h p
Bodie, Col	"	12½	3400	160	Successful.
Rome, Italy	"	18	6000	2000	In'ing to 9000 hp 3 yrs.
Davos, Switzerland	"	2	3660	600	Successful.
Schongeisung, Germany	"	4½	2600	820	"
Springfield, Mass	2-phase Alt.	6½	3600	820	"
Quebec, Canada	"	8	5000	2130	"
Anderson, S. C	"	8	5500	200	"
Fitchburg, Mass	"	2¼	2150	400	"
Winooski, Vt	3-phase	2½	2500	150	"
Baltic, Conn	"	5	2500	700	"
St. Hyacinthe, Canada	"	5	2500	600	" 2 years.
Concord, N. H	"	4	2500	5000	" 2 years.
Fresno, Cal	"	35	11,000	1400	" to be increased.
Big Cotton wood to Salt Lake City, Utah	"	14	10,000	1400	"
Lowell, Mass	"	6 to 15	5500	480	"
Sacramento-Folsom, Cal	"	24	10,000	4000	1 year.
Redlands, Cal	"	7½	2500	700	3 years, extending lines in other towns.
Lauffen to Frankfort, Ger	"	100	30,000	300	(Experimental.)
Lauffen to Heilbronn	"	9	5000	600	Successful.
Oerlikon Works, Zurich, Switzerland	"	15½	13,000	450	"
Portland, Oregon	"	12	6000	5000	"
Silverton Mine, Col	"	4	2500	400	" to be increased.

It will be seen that the longest transmission is at Fresno, Cal., the distance being about 35 miles. The highest alternating voltage used is 13,000 volts, at Zurich, Switzerland. The highest direct potential is 15,000 volts, at Brescia.

All of these plants are working successfully, and this fact will lead to still longer transmission and higher voltages. No limit of either distance or potential has as yet been reached. If we consider the record of the present transmission plants, we can safely say that it would not be going outside of the safe limit of development to transmit at least 50 miles at a potential of 20,000 volts, provided the energy could be delivered at such a price as to be considerably lower than the cost of a corresponding amount of energy obtained from a steam plant. This, of course, is a matter of local condition entirely, and the commercial value of such a transmission will depend upon local conditions.

LONG-DISTANCE TRANSMISSION FOR RAILROAD WORK.

The possibility of long-distance electric railroad lines is intimately connected with the possibility of long-distance transmission of power. We have seen that it is possible to transmit considerable distances from a single station. The current so distributed is not, however, such that it can be applied directly to railroad motors, but it must be transformed at points along the line, the distance apart of these points of distribution depending upon the system that is employed. At present continuous-current motors are used and considerations of safety would lead us to use line potentials not greater than 700 volts. By distributing rotary transformers at distances of five or six miles apart, we would be able to supply motors with current without any great investment in copper. The amount of copper required could be still further reduced by using rotary transformers with storage batteries, thus keeping a constant load on the transmission line. It will be found, however, that on any long-distance railroad line, the load on any section of the line is exceedingly variable, and the discharge rate of the batteries will have to be very high in order to prevent excessive cost for our reducing stations. It is doubtful whether we have reached a point in battery construction in which this system of transmission would be economical. It is certain, however, that when the distances are comparatively short, say within 15 miles, and where the traffic is not evenly distributed, that rotary transformers, with or without batteries, can be economically employed for railroad work.

CONCLUSIONS.

My conclusions, subject always to the influence of local conditions, are as follows:

1. In both direct-current lighting and traction systems, where the power is generated in or near the area of distribution, it is best to use one station, situated at the most economical point for producing power.

2. In the case of the traction systems, when the economical area of direct distribution is passed, boosters should be employed directly or in connection with batteries, to a distance of 10 or 12 miles from a station, and beyond this rotary transformers, whether with or without batteries, should be used.

3. In the case of direct-current lighting systems, the energy should be transmitted to storage batteries situated at centres of consumption, either directly or by means of a rotary transformer, and distributed from them.

4. Where batteries are used it is best to place them at the end of feeder wires to obtain the advantage of a constant load on the wire.

5. The best system for the long-distance transmission of energy for general purposes is the three-phase alternating system.

6. Commercial transmissions are in successful operation for distances of 35 miles, and for voltages as high as 15,000 volts.

Experience with these plants shows that the transmission to 50 miles with a pressure of 20,000 volts is practicable; beyond these limits the transmission would be more or less experimental.

Electrical Disturbances in Submarine Cables.*

BY W. H. PREECE.

Many interesting problems arise from time to time in the practical applications of electricity which tend to develop or confirm theoretical deductions on a scale beyond the dreams of the laboratory experimenter. In no branch has this been more pronounced than in submarine telegraphy. Long ocean cables contain invariably only a single core.† Multiple cables, that is, cables possessing more than one core, are usually short in length, and are in consequence free from those disturbing elements which, existing in long lengths, make such circuits difficult to operate successfully. A *disturbance* is the result of the expenditure of energy in the wrong place. It tends to loss of efficiency. In telegraphy this means mutilation of signals and loss of speed in working. In telephony it means indistinctness of speech, the presence of extraneous and distressing sounds, or the reduction of distances through which speech is practical.

The longest multiple cables worked by the British Post Office are those connecting the coast of Suffolk and Norfolk with Germany, and these cables have four cores each.

The following table gives their lengths and particulars:

Name of cable.	Date laid.	Length in naut. miles.	Capacity in microfds. K.	Resistance in ohms R.	KR.‡	Remarks.
Lowestoft-Norderney	1866	225	73.1	2,710	198,100	No brass tape.
Lowestoft-Borkum	1871	225	66.0	2,666	175,950	Ditto.
Bacton-Borkum	1891	211	63.0	2,380	149,940	Ditto.
Bacton-Borkum.	1896	224	84.0	1,500	126,000	Sep'te brass tape round each core.

The Norderney and other cables in the North Sea having been attacked and punctured by the *Limnoria terebrans*, a small boring mollusc, it was decided to cover the cores of all new cables with brass tape armor, an effective remedy against this depredator. Hitherto brass tape had been used solely for this particular purpose. It was wrapped round the whole of the cores after they were stranded together; but, for other reasons which will appear, the second Bacton-Borkum cable, laid this year, had each core separately and independently protected.

* Paper read before the British Association at Liverpool, Section A.

† The term *core* is applied to the copper conductor and its insulating sheath or dielectric.

‡ The product KR expresses the law that the time constant of a circuit varies as the product of its active capacity and its ohmic resistance.

These four cables, forming 16 circuits, are worked as a rule by the Hughes type-printer, but on two circuits the double-current Morse system is employed. In all cases the earth is used as the return. The presence of disturbances from induction was first seriously brought under notice after the laying of the Bacton-Borkum cable in 1891. This cable is one of the ordinary four-core P. O. standard type, without any brass taping, a section of which is shown in Fig. 1. On commencing to work the four wires it was found that, although we had a perfect cable, with better copper and gutta-percha of lower static capacity than usual, the Hughes working upon the four circuits was very unsatisfactory. Twelve months after its

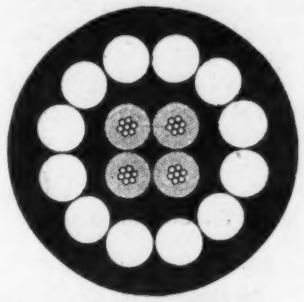


Fig. 1.—Ordinary Four-Core Submarine Cable. Deep-Sea Type, 107 Pounds, Copper, 150 Pounds G. P. to Scale.

submersion a series of observations was made upon the three then existing Anglo-German cables, when it was made clear that there was still very much more disturbance upon the 1891 Borkum than upon the old cables *via* Lowestoft. After very careful examination and consideration it was concluded that the difference was due to the better mechanical condition of the new cable upon which the compound was still practically sound, preventing a complete and continuous soaking with water of the hemp yarn round and between the cores, with the consequent absence of the shielding effect which existed in the older cables, owing to their more thorough saturation. It was consequently assumed that the new cable would improve with age. But this disturbance presented itself in a more serious manner when attempts were made to work *duplex* Hughes, and also when testing the Wheatstone automatic system upon one of the cores. It was found that duplex Hughes was just possible, but owing to the disturbance from the other cores the signals were mutilated so frequently that working was too unreliable for ordinary business. The disturbances from Wheatstone working were still more serious. The Hughes apparatus is worked by short, sharp, intermittent currents, separated from each other by varying intervals of time. These time intervals determine the letter to be printed.

The causes of disturbance are induction and leakage. The latter may be ignored, for the insulation of our cables is practically perfect. The induction may be either *electrostatic* or *electromagnetic*. The former is the primary agent in reducing the speed of working in telegraphs, and in deteriorating the clearness of speech in telephones. A part of the energy of the current is absorbed by the capacity of the line and stored up as a charge, producing in discharge retardation and prolongation of signals. Electrostatic induction between core and core is the principal cause of the disturbance between the conductors of multiple cables. Electromagnetic induction also produces serious disturbances on straight parallel circuits with earth return, whether used for telegraphs or telephones; but between the two wires of a metallic circuit it may have a very beneficial influence in telephone working.

It is very easy to differentiate the electrostatic from the electromagnetic effects. The former differ in direction at each end of the circuit when discharging. The latter maintain the same direction throughout. The former vary with the *voltage*, and the latter with the *amperage*.

During the experiments with the Wheatstone system, to which I have referred, it was found that the disturbances on the Hughes circuits, due to automatic sending on another core of the same cable, increased with the rate of working. Thus, with the same voltage, *viz.*, 80, at

Key speed (30 words per minute), the effect was negligible.

Automatic (40 words per minute), the effect was distinct.

Automatic (50 words per minute), the effect was serious.

Maximum speed of the cable (70 words per minute), the effect was prohibitive.

The greatest disturbances were observable when automatic and Hughes were working in opposite directions. The signals on the Hughes were sometimes in advance and sometimes in retard. Hence they were so greatly mutilated that Hughes working was impossible. This was due to the *consonance* which occurs in two parallel circuits. When the mutual inductive influence, either electrostatic or electromagnetic, or both, between them, produces in either conductor greatly increased or greatly diminished currents, the one will advance and the other retard the signals so as to render telegraphy impracticable. The brass tape around each core entirely shields the conductors from electrostatic induction. The separate and independent brass taping of the 1896 cable has fully complied with my anticipations. The disturbances upon the cables are reduced to a negligible extent. They are one sixth of those observed on the 1891 cable. They would entirely disappear if we could remove the electromagnetic effects. The possible rate of working, after several months' submersion, on the new cable, is 33 per cent. greater than on the 1891 cable, but this is due chiefly to the reduction of the K R. The improvement in the signals is shown by the two recorded curves (Fig. 2).

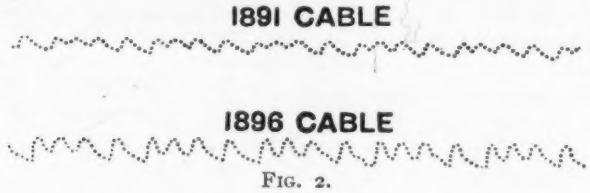


Fig. 2.

The time constant* of the 1891 cable is 0.0513 second and that of the 1896 is 0.0450 second, measured by the Hughes instrument, which is a capital chronograph.

TELEPHONE CABLES.

An important form of multiple cable to consider is that required for telephone working. The cable connecting England and France forming the Channel section of the London-Paris telephone circuit has cores of the ordinary type, as shown in Fig. 1, using gutta-percha as the insulating medium, but with its capacity and resistance reduced to a minimum. It gives two circuits between London and Paris, and works very satisfactorily; but we want to bridge over greater distances, and eventually we hope to reproduce speech even across the Atlantic. The Dover-Calais type would not do for a greater distance than say 30 nautical miles. The distance to Belgium is 47 nautical miles, to Holland 108, to Germany 211 nautical miles. With paper as the dielectric, having half the specific inductive capacity of gutta-percha, and with our later experiences of air spaces, cannot we devise a new form of cable that will bridge over these greater distances? We must eliminate all disturbances, and we must reduce capacity and resistance to their lowest limits. The former is simple, for well-insulated, symmetrically twisted metallic circuits are free from all external disturbances. The latter is more complicated, and is surrounded with great practical difficulties. The problem is to diminish the time constant of a metallic circuit so that it shall approach zero.

If there were no time constant, current waves would rise instantly to their working maximum, and as rapidly fall to zero. If we could materially diminish the causes of retardation in such cables, speech by telephone would be possible to great distances. This can be done theoretically by neutralizing the effect of static capacity by the opposite effect of electromagnetic induction.

The conditions which retard current waves and thus determine the time constants in single conductors embedded in a solid cylindrical dielectric are very different to those which act in double conductors or parallel metallic loops. Lord Kelvin in 1855 dealt with the cases of direct currents and distributed capacity in a complete single circuit.

The surface of the conductor in such a cable is one plate and the earth the other plate of a condenser. At every point of the course of the current this capacity must be satisfied. Work is done on the dielectric in establishing an electric field. Lines of electric force are formed through the medium, varying in number with the force exciting them, and with the thickness and specific inductive capacity of the dielectric. Energy is stored up The charge thus held must be neutralized or dissipated. Discharge to earth through each end is the result, and this, with the resistance of the circuit, produces retardation of signals.

Neutralization has been attempted in submarine telegraphy by sending reversed currents, but with only partial success.

With parallel conductors and telephone working the conditions

* The *time constant* here referred to is the time that the current takes to rise to the necessary strength to work a relay in normal adjustment.

are very different. The total energy expended in any circuit in a given time may be considered under three heads:

1. That expended in overcoming resistance.
2. That expended in producing the electric field.
3. That expended in producing the magnetic field.

In each case we must consider the energy stored up and that dissipated. The former tends to retardation, the latter to work done, and therefore to reduction of efficiency. Careful regard must be paid to the directions in which the different disturbing forces act, for it may be that they oppose each other, and direct the energy into the original channel under modified and more favorable conditions. Thus, if the whole effect of the electrostatic field is neutralized by that of the electromagnetic one, the total energy developed is expended on the circuit itself, disturbances are eliminated, and the service improved. This is the case of a metallic circuit having a microphone transmitter at one end and a telephone receiver at the other. The capacity of such a system will tend to store up a portion of the energy of each current, but the electromagnetic induction between them will tend to supply the deficiency. If the two wires of the loop be far apart the influence of mutual induction will be much less than that of capacity. As they approach, the electromagnetic induction must increase at a greater rate than that of the electrostatic induction, until finally at the limit when they coincide, the one must exactly neutralize the other. This, perhaps, is better seen if we consider the case of a concentric cable; for in this case the number of lines of electric force does not increase, while the number of lines of magnetic force cutting the other conductors does increase rapidly as the outer conductor approaches the inner. The maximum induction from each source must take place when the two conductors are infinitely near each other, and this maximum must equal the primary current, for it cannot exceed it unless there were fresh creation of energy. Thus, as the separating dielectric becomes smaller and smaller, the two effects approach each other closer and closer, until, at absolute contact, they annul each other. The result must be that if these be the only conditions present, the time constant must diminish as the two conductors approach each other, and in the limit it must disappear. Twenty miles of concentric cable (Fig. 3) insulated with paper were made and laid in the streets of London to test this reasoning, and comparisons were made with ordinary parallel cylindrical conductors, insulated both with gutta-percha and with paper and air. The result was very encouraging; but an unsuspected difficulty arose from the want of symmetry of the capacity of each conductor and the earth. The insulation resistance of each conductor was also different, and the result was that when the concentric cable was joined to overground wires, serious disturbances were experienced in the working circuits, which were remedied by crossing the conductors of the concentric cable at several points, so that each side of the circuit was sometimes the inner and sometimes the outer conductor. This, however, is a cure that could not easily be applied to a submarine cable. It is clear that such a cable symmetry of capacity with earth and of insulation is essential.

The experiment with the concentric cable shows that we have to consider not only the capacity between the two conductors, but that between each conductor and earth. Symmetry can be produced if the conductors be shaped and arranged as in Fig. 4. Only a certain number of lines of electric force, dependent on the voltage present, can emanate from each conductor. The closer *a* and *b* (Fig. 5) are

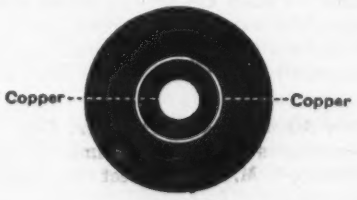


FIG. 3.

[FIG. 4.

to each other, and the further they are from the earth, the greater the number of lines between the conductors and the fewer to the earth. The electric field is, in that case, confined almost entirely to the space between *a* and *b*.

Taking the transverse action upon each element of such a core working telephones, each conductor is a source of periodic and opposite alternating electric force, and a displacement current passes through the dielectric that separates *a* and *b*, varying not only with the electric forces and the spacific inductive capacity, but with the frequency of the alternations. There is no storage of energy. It is dissipated as heat, but this heat, with the very small amount of energy expended in telephone working, cannot be sensible. It must, however, ultimately limit the distance at which we can reproduce speech.

Taking the longitudinal action per unit length of each conductor, since there is no storage, but only a small expenditure of energy between the conductors, the rate of fall of voltage must be slightly greater than that required by Ohm's law. It should not, however, cause retardation, because that is the result of storage and release of energy. It is different, however, with the condenser action between each conductor and earth. Here there must be some storage

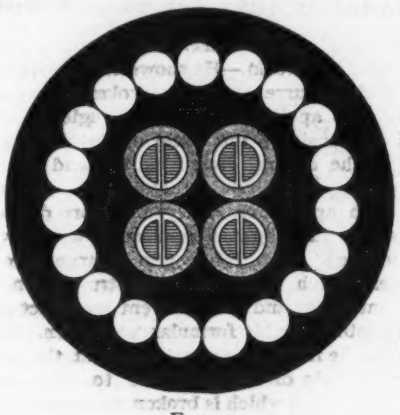


FIG. 5.

of energy, but for the reason given this must be small; and in an insulated system like a telephone circuit, and with a thick dielectric sheath the effect may possibly be neglected.

The problem resolves itself into a practical question: What is the best form to give the cable with our existing experience and our available materials? My present solution is given in Fig. 5. The conductors are insulated first with paper and then with a thick coating of gutta-percha. Paper only exists between the conductors. The cable is sheathed and compounded in the usual form. There are four circuits, instead of two, as at present in the London-Paris cable.

With such a cable I have little fear of speaking between England and Germany; but to test the practical points that arise in the manufacture of such a cable it is proposed to make and lay a short one to the Isle of Wight. If my reasoning is correct, and so far experiment has confirmed it, then not only ought we to be able to speak to great distances, but the type of ocean cables must be revolutionized, for what is true for telephony must be equally true for telegraphy. Cables such as those across the Atlantic might, with the same weight of copper, be made to transmit a greater number of words per hour than they do now.

The St. Louis Convention.

A special train will leave New York for St. Louis to carry the Eastern delegates to the convention of the American Street Railway Association. The train will leave the Grand Central Station, Forty-second Street, New York, at 1 p. m. Saturday, Oct. 17, and will travel over the New York Central & Hudson River Railroad and connections, arriving at St. Louis at 6.56 p. m., Sunday, Oct. 18 As has already been stated a special rate of a fare and one third for a round trip has been granted from all Eastern points. On purchasing tickets delegates should ask the ticket agent for a certificate which, when properly countersigned at St. Louis, will entitle the holder thereof to a return trip at one third the regular fare. The convention will open on Tuesday, Oct. 20, at 10 o'clock a. m.

Submarine Telegraph Memorial.

A meeting was held in London on Oct. 6 for the purpose of inaugurating the International Submarine Telegraph Memorial. The Earl of Selbourne, in taking the chair, stated that the object of the meeting was to put upon record the administration of the authors of international submarine telegraphy, especially Cyrus W. Field, Sir John Pender and James Anderson. The determination of the form of the memorial was referred to a committee, of which the following named gentlemen are the members: Viscount Peel, Lord Kelvin, Lord Tweeddale and George von Chauvin, the London representative of the Western Union Telegraph Company.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS.

BY CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Sparking. FISCHER-HINNEN. *Elek. Zeit.*, Sept. 24; the conclusion of his article (see *Digest* last week).—He shows how his formulas are applied to the calculation of the current which is broken at any given position of the brushes; he also applies them to the angle of the shifting of the brushes; in this he considers the ratio of the shifting of the brushes, to the distance of the neutral zone from the end of the pole-piece, a factor which is an important one in passing an opinion on a dynamo; the more this ratio approaches unity, the more difficult it will be to set the brushes, as the slightest movement will have an important effect on the voltage. Two tables give a large amount of tabular data of machines which have been constructed, including those of numerous different types and of different manufacture; the various constants and variables for his formulas are given. In discussing the subject of sparking, he makes the hypothesis that the amount of sparking depends on certain direct relations to the energy which is represented by the current which is broken, and on an indirect relation which is not yet definitely known, to the speed with which the interruption takes place; even when the theoretical requirements are made small, sparking may still take place in the best machines, and he attributes it to the variation of the brush contact and the differences in the resistance at the soldered junctions on the armature; the difference in the shifting of the brushes for motors and dynamos is discussed analytically; he concludes that the number of soldered joints should be as small as possible and the winding of the armature should be as symmetrical and uniform as possible; the number of commutator bars should not be too small and is dependent on the output; especially with high voltage machines the voltage between two bars should not exceed 30 to 40; some other conclusions are drawn regarding the probable values of certain relations in his formulas; if a machine sparks it can be improved by increasing the diameter of the boring through the armature and by diminishing the distance between the ends of the pole-pieces, but it is advisable to calculate the results of such a change first, in order to find whether it will really be of advantage. Regarding the Sayers winding, which he says can be calculated readily from those formulas, he points out a disadvantage over the arrangement suggested by Swinburne to put a small auxiliary magnetic pole in the neutral zone; if the Sayers winding is proportioned for the maximum current the action will be too great when the machine is unloaded, and it will then give rise to sparking; the diameter of the commutator should be as small as possible, and the number of teeth of the armature should be increased as much as possible; it may also be better to distribute the winding of a coil between two grooves; the loss due to ohmic resistance should be reduced as much as possible.

Calculation of the E. M. F. of a Portion of a Gramme Ring. LOPPE. *Bul. Soc. Int. des. Elec.*, July.—A short article giving equations for the E. M. F. in portions of a Gramme ring armature revolving in a magnetic field, for continuous, alternating, two-phase and three-phase currents.

Alternator. Lond. *Elec. Rev.*, Sept. 25.—An illustrated description of a new form of Mordey alternator of the iron core type, in which both the conductors are fixed and only a portion of the iron of the magnets moves.

Complete Test of Modern American Transformers of Moderate Capacities. FORD. *Bul. Univ. of Wis.*, Vol. 2, No. 1.—The whole number of 88 pages is a publication of his complete set of tests, an abstract of which was read before the Northwestern Electrical Association in July, 1895. It is prefaced by an introductory note by Prof. JACKSON, in which he states that these results show very strikingly that the cheapest transformer is not always the most economical, and that individual tests of each transformer purchased are essential to assured economy; transformers should be purchased under guarantees, and every superintendent should test each one at least for iron loss and regulation; tests which are easily made with an ordinary wattmeter, such as may be found in the market, reading from 0 to 200 watts; he gives diagrams of the connections for testing the iron and copper losses and regulation; for the iron loss the secondary should be connected to the regular secondary circuits with a wattmeter included, and the primary open; for the copper losses the quickest approximate method is to connect the primary in series with some resistance, to the alternating lighting circuit and short circuiting the secondary through an ampere meter; for full load the wattmeter then gives the copper losses; the drop in pressure is measured by connecting the secondary to the lighting circuits and reading the primary secondary voltages, after which the transformer is loaded and the pressure again read. The guarantees which should be required he gives as follows: The iron losses should never exceed those given in an adjoining table, which vary from 30 watts for a 1-kw transformer to 80 for a 4-kw; the drop should not exceed 3 per cent. between no load and full load; the rise of temperature during the 10 hours should not exceed 70 degrees Fahr., or 40 degrees C.; the disruptive strength, when heated, should be at least 10 times the primary pressure, and the insulation when heated not less than 10 megohms and should be guaranteed not to deteriorate; the exciting current should not exceed the values given in a table which vary from 0.035 amperes for a 1-kw to 0.20 for a 7.5-kw; these guarantees can be easily made and are now made for the transformers of a number of makers; many of the older transformers in use are wasting so much power that considerable profit might be shown if they were replaced by new ones; periodic tests should be made at intervals of one year; the iron losses usually increase after the transformers have been in service. This is followed by the main article of FORD, which consists largely of the tables and curves of results; all of the 20 transformers tested were of American make except two; they are all of recent design and are approximately of the same capacity; he states that it is the only test which has been made of so many different transformers under the same conditions; he tested the copper loss, the iron loss, the open circuit or exciting current, the regulation, the rise in temperature and the insulation. The various methods of testing are discussed. In a discussion of the results he shows that large corrections had to be made for instrumental errors; he also shows the one wattmeter method of Sumpner is much better than the two wattmeter method, both in accuracy and ease of making the measurements; the most noticeable difference in American transformers from one to ten kilowatts is in the iron losses; in those in which this loss is small the efficiency is nearly as good for a frequency of 60 as for 125; the regulation is better when the coils are longer in the axial direction than when they have a square cross-section; the constant-current transformers, whose primaries are at constant voltage, will work only at the frequency for which they are designed, if the magnetic leakage is depended upon to keep the current constant; the surface of the core and exposed parts of the coils should measure at least five square inches per watt lost at full load, and the area of the case should be at least seven square inches for each watt lost; the economy in the operation of alternating-current stations demands the most careful selection of transformers, a low-priced transformer with a large core loss being an expensive investment; the point of maximum efficiency had better be at or below half load instead of full load, as in the majority of cases.

Design of Arc Light Dynamos. ALBERS. *Elec. Eng.*, Oct. 7.—An illustrated description of his composite inductor dynamos. He believes that the arc lighting station of the near future will consist of large dynamos with multiple circuits, being an aggregation of units, each of which has its own magnetic circuit, armature, field-coil and regulator but having its moving part in common with the whole station; the dynamo may be a multiphase alternator with commutators for each circuit running in synchronism with it; the present machine is an example of this kind. A station furnished with such dynamos would have a very large output in proportion to its size; he believes that the system is more flexible than the old way of having a dynamo for each circuit; he thinks there is a fertile field within the two rather near extremes, of which one is represented by the multiphase alternator with a separate commutator in each circuit and the other by an aggregation of nearly independent units, as in the inductor which he describes.

Counter E. M F. in Induction Motors. CARHART. *Elec. Eng.*, Oct. 7.—A short article showing the analogies between the counter E. M. F. in an induction motor and the reactive E. M. F. in a direct current machine.

LIGHTS AND LIGHTING.

Incandescent Lamp Tests. PREECE. Lond. *Elec. Rev.* and *Elec. Eng.*, Sept. 25.—The beginning of a reprint of a B. A. paper, including a large number of curves which are published in the former journal in the form of a supplement. The tests were made in order to establish a fair and reasonable specification for the Post-Office requirements, and to find an expeditious and reliable way of testing the efficiency and durability of lamps submitted in competition. The experiments were conducted on the following lines: to find the efficiency and life of 100 and 105 volt lamps of 16 and 8 candle-power in a 2000 hours' trial, when kept burning continuously; to find the efficiency and life under similar conditions but only to be lighted for several consecutive hours daily; a similar test except that the duration is limited to 1000 hours; to find the mean breaking voltage of filaments by gradually increasing the voltage at about the

same rate for each lamp; to see what the effect would be on similar filaments after being raised to three fourths of their mean breaking voltage; the tests were carried out with continuous currents. The present portion consists almost entirely of tables and curves of the data; no conclusions are drawn in this portion. In an editorial note in the *Elec. Rev.* it is stated that the tests corroborate those of Ayrton in showing an increase of candle-power at first with a subsequent falling to below the original; it is stated that the formula given in the paper, by which the cost per candle-power-hour can be obtained, will do good service; it is pointed out that a medium efficiency lamp with a fair life is better than one with one extreme virtue but lacking the other; the specification for lamps is commented on favorably.

Induction Incandescent Lamp. MEYER. *Elek. Anz.*, Sept. 24.—An argument in favor of an incandescent lamp having the secondary of a small transformer in the bulb of the lamp itself, the primary being in the lamp socket; by thus avoiding the use of leading-in wires he believes that the vacuum will not deteriorate.

Street Lighting by Incandescent Lamps. WALKER. Lond. *Elec. Eng.*, Sept. 25.—A reprint of a B. A. paper in which he expresses the belief that the series-incandescent system will be used more in the near future; after pointing out the advantages of the system he gives a brief description of the one which has been in steady use for four or five years at Kingswood, where the Parfit system is used.

Photo Printing of Tracings by the Arc Light. BLAKE. Lond. *Elec.*, Sept. 25.—He states that with two 6-ampere naked lamps with a white paper reflector behind them, it takes about four hours to get a good print with an ordinary quality of blue paper; the position of the frame should be changed occasionally as otherwise the print will be patchy; a five-minutes exposure to a clear sky gives a far better print and he therefore discourages the use of the arc except when absolutely necessary.

Reactive System of Arc Lighting. SPENCER. *Jour. Frank. Inst.*, October.—A reprint of a paper giving a brief discussion of the various alternating arc light systems with special reference to the Horry reactive system of series alternating-current arc lighting, which was described in the electrical journals some time ago, and consists of a small reactive coil placed in the top of each lamp, the arc itself being connected as a sort of shunt to a portion of the coil, thus the coil acts partially as a transformer and partially as a reactive coil; the original part of the paper gives an analytical discussion of the actions of these coils, showing that the relations between the secondary E. M. F. and secondary current is represented by part of an ellipse, and that by diminishing the amount of iron in the coil the ellipse may be so flattened that a coil produces practically a constant potential through a large region of variation of the secondary current.

Denayrouse Gas Burner. Elec. Eng., Oct. 7.—An illustration of the one mentioned in the *Digest*, Nov. 30, 1895, which has a Welsbach burner combined with a small electric fan motor which establishes a thorough mixture of the air and gas before it is ignited; an elaborate calculation in the French journal from which the cut was taken shows that for the same money a Welsbach gives four times and this nine times as much illumination as the Butterfly burner.

Lighthouse Illumination. PRELLER. *Prog. Age*, Oct. 1.—An abstract of some length giving some data of his recent paper, noticed in the *Digest*, May 23.

POWER AND HEAT.

Electric Furnace. MOISSAN. Lond. *Elec.*, Sept. 25; reprinted from *Nature.*—A brief reference to a recent paper giving an account of his experiments with refractory substances, in which he concludes that the most refractory compounds hitherto known are either decomposed or electrolyzed in the electric furnace, and that nothing resists these temperatures except the series of perfectly crystallized compounds discovered by him, consisting of borides, silicides and carbides of the metals; he regards these as probably among the original constituents of the globe and still existing in some of the stars.

Calcium Carbide Furnace. Lond. *Elec. Eng.*, Sept. 25; abstracted from *L'Ellettricita.*—A brief description of the LORI system; the furnace is lined with carbon and has a carbon anode through the top, the cathode being a horizontal plate of carbon; the furnace is practically gas-tight in order to save the carbonic oxide, which is one of the products formed; this is collected and is then burnt in a chamber surrounding the furnace, thus raising the initial temperature and the feed to as high a point as possible, thereby diminishing the amount of heat which must be generated by the current.

Electric Cranes. ANDERSON. Lond. *Elec.* and *Elec. Eng.*, Sept. 25.—A reprint of a B. A. paper giving some of his experiences with electric cranes in practical use, and including some comparisons with steam and hydraulic cranes.

Gas vs. Electricity for Power Transmission. PERRY. *Eng. Mag.*, October.—The first part of a long article comparing the cost of the transmission of energy by means of electricity and by means of gas. He shows that for short transmissions, as for longer ones, the electrical method is by no means the most economical, although for the general purposes of the distribution and subdivision of power it is supreme; for transmission purposes the energy should be in the potential form and for distribution and subdivision in the kinetic form; in a calculation he shows that it would cost 145 times as much, under certain given conditions, to transmit electrical energy a distance of one mile, as it would to transmit it in the potential form of coal, the latter cost being based on the cost of transporting coal by railroad. He then discusses the transmission of energy in the form of gas and oil in pipes; he takes the case of a large station in New York and shows that it is paying 54 cents a ton more for the fuel than if it were located at the depot of supplies and he shows that the cost of transmission for the additional distance more than balances the saving effected by a change of location; while the electrical method is by far the best known for local distribution, for local transmission it is not equal to the coal cart. He discusses the question of storage, the importance of which he points out; the storage battery will store 3-hp hours per cubic feet and its weight efficiency is 16.5 pounds per hp-hour at normal discharge; in Halpin's thermal storage system at 265 pounds pressure, a space of 4.5 cubic feet for condensing engines and 7 for non-condensing engines is required for an effective electrical horse-power-hour; for water storage, at 100 feet height, a space of 352 cubic feet per electrical horse-power-hour is required; in gas storage 20 to 25 cubic feet are required for illuminating gas, and 75 to 100 for Dowson gas. He discusses the question of converting coal into gas at the water front or railway line, and transmitting it to gas engines at the centres of distribution; he gives a table for the transmission of gas 5000 yards through a 12-inch pipe with bends at various pressures, and compares the cost of such a gas pipe with a copper wire for transmitting the same energy, the latter costing four times as much. "It is not theoretically possible to transmit energy electrically in municipalities as efficiently or as cheaply as it is actually accomplished to-day by gas"; this supply is only to comparatively short distances, as the efficiency of gas transmission varies inversely as the pressure, while with electricity it increases directly as the pressure, so that a point will be reached where the relative conditions are reversed.

Transmission Plant Near Montreal. Elec. Eng., Oct. 7.—A brief description of the proposed plant in which the power of the Lachine Rapids is to be used; it is said that it will be the second largest electrical plant in the world; its construction was begun a few weeks ago; the present description refers only to the water-power plant.

Niagara Falls Transmission Plant. MARTIN. *Jour. Frank. Inst.*, October.—The beginning of a reprint of a lecture delivered last January giving an illustrated description of the plant.

Big Cottonwood Power Transmission Plant. Jour. of El'ty, August.—A well-illustrated description of this plant.

Power Required by Metal Working Machinery. DODGE. *Amer. Mach.*, Oct. 8.—Additional data giving the results of some tests made with machines driven by electric motors. The data is that for various boring machines and planers.

Electric Mining Machinery. HALE. *Elec. Rev.*, Oct. 7.—A reprint (without acknowledgment) of that portion of the paper noticed in the *Digest* last week referring to the discussion of the various electrical machinery used; the tables are not reproduced.

Elevator Apparatus. Amer. Mach., Oct. 8.—An illustrated description of the snap switch and the ball nut of the Sprague elevator.

Water-Wheel Regulation. Jour. of El'ty, August.—An illustrated description of the Lighthipe electric regulator for water-wheels.

TRACTION.

Surface-Contact System in Paris. TAINTURIER. *Bul. Soc. Int. des Elec.*, July.—An illustrated description of the line running from the Place de la Republique to Romainville, in which the Claret-Veuilleumier system is used (numerous references to descriptions of this system have already been given in these columns).

Electrolysis of Gas and Water Pipes. Prog. Age, Oct. 1.—A brief abstract from a pamphlet issued by the electrical bureau of the National Board of Fire Underwriters, giving a summary of the opinions of leading electrical engineers on this subject. It is claimed that water mains have broken down on account of faults unquestionably due to electrolytic action and smaller pipes have been weakened so as to break down at critical moments; measurements show that conditions unquestionably exist in nearly every district in the United States covered by a trolley road, which are favorable for destructive action; the general nature of this action is explained; it is said that whenever a deflection is shown on an ordinary voltmeter registering tenths of a volt when the positive pole is connected to a water pipe and the negative " with an adjacent lamp post, car track or metal rod driven in the earth, electrolytic action will be found upon examination to be taking place at that point, which will ultimately result in the destruction of the water pipe." Some remedies are mentioned and it is stated that by judicious use of these it has been demonstrated that the evil can be so largely reduced as to be practically negligible.

Electrically Operated Railway. Elec. Eng., Oct. 7.—A brief description of the Aylmer branch of the Canadian passenger railway from a suburb of Ottawa, which is operated by electricity; besides passenger

and mail traffic it handles all the through and local freight, which is considerable, requiring 50 to 75 cars per day; there are 36 regular trains running each way per day; the power is obtained from the Deschesne rapids; the locomotive, which was the first operated in Canada, weighs over 20 tons and has double trucks, each axle being equipped with a motor; it develops a drawbar pull of 10,000 pounds; the external view of the locomotive is given.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Transformer Sub-stations and Individual Transformers. Wagner. *Elek. Zeit.*, Sept. 24.—A communication criticising some of the comparisons made in a recent report (see *Digest*, Sept. 26) of the alternating-current station at Frankfort-on-the-Main; in that comparison it was concluded that an alternating-current station with only a primary network and individual transformers, is more economical in its operation than those with primary and secondary networks and transformer sub-stations. He gives some comparative data for the Zurich station, which differs from the above in that both the primary and secondary network are separated, the primary being a two-wire system and the secondary a three-wire system; he shows thereby that the statement that there is no saving in the transformers when transformer sub-stations are used is not correct; the largest momentary total loss with primary and secondary networks is greater than with individual transformers, but this maximum loss takes place only during one or two hours per day and during a few weeks per year, and therefore it should not be given too much importance. The transformer sub-station system has the following important advantages: The mean load will be considerably greater than with individual transformers; individual transformers must be proportioned for each possible maximum, while with sub-stations the transformer need be proportioned only in accordance with the actual maximum, which in Zurich was found to be 65 per cent. of the maximum calculated from the number of lamps connected; the mean yearly efficiency in sub-stations is therefore higher than with individual transformers; during the Summer month some of the sub-station transformers may be disconnected, as is done in Zurich; the larger loss with primary and secondary networks is therefore only apparent; the insulation of the primary is also more easily maintained. He concludes that a happy medium might be the best—that is, the use of sub-stations in dense districts, where there is a good load, and the individual transformer system in the outlying districts; this is the system used in Zurich.

Alternating-Current Lighting Station. Wagner. *Elek. Anz.*, Sept. 20 and 24.—A conclusion of his article (see *Digest* last week); in this portion he gives an illustrated description of the station in Zurich which is a pure alternating-current station; a number of load diagrams are given.

Vienna. Elek. Zeit., Sept. 24.—An illustrated description of the central station which was completed in 1890 and is the largest station using the Ganz alternating-current system.

Frankfort-on-the-Main. Ross. *Elek. Zeit.*, Sept. 24.—A short communication pointing out corrections in the recent article (see *Digest*, Sept. 26) giving the operating costs of this station and showing that no conclusions regarding the relative advantages of the secondary network can be drawn from the data given.

Large Isolated Installation in Paris. L'Energie Elec., Sept. 16.—A very long illustrated description of the continuous-current installation in the establishment of La Belle Jardinière.

Continental Electric Lighting Statistics. Ross. Lond. *Elec.*, Sept. 25.—A translation of the article noticed in the *Digest*, Oct. 3.

Fire Insurance of Central Stations. Lond. *Lightning*, Sept 24.—An article discussing the causes of the insurance companies for treating central stations as a specially hazardous risk; it includes a number of extracts from letters from the managers of a number of English stations in reply to a suggestion for the formation of a mutual organization.

Copenhagen. West. Elec., Oct. 3.—An abstract of an article from *L'Ind. Elec.*, Jan. 10, with some of the illustrations descriptive of the station, one of them being the switchboard diagram. A more complete description of this station was noticed in the *Digest*, Sept. 28, 1895.

WIRES, WIRING AND CONDUITS.

Calculation of Wires. Blondel. *Bul. Soc. Int. des Elec.*, July.—A short article supplementary to the one by Bochet (see *Digest*, Aug. 1). He refers to the theorem of Santarelli, who showed an analogy to the calculation of the diameters of pipes for the distribution of water; he showed that for any network of wires carrying given currents, the cross-section of the wires should be proportional to the square roots of the currents in order to give the most economical cross-section. From this the present author deduces other conclusions; for a conductor "along which the current is distributed uniformly at the rate of i amperes per unit of length" he shows that the density of the current is also proportional to the square root of the current; if the values of the cross-section are laid off as ordinates, the curve will be a parabola, while for a cylindrical conductor it would be a horizontal line and for a conical conductor an oblique line; he then compares these three types of conductors for the fall of potential and the weight of copper; for the same initial density of current the fall of potential between the extreme end will be two thirds for the parabolic wire, one half for the cylindric and one for the conical; the quantities of copper in the three cases will be in the proportion of eight ninths, one and one respectively, showing a saving of one ninth in favor of the parabolic wire; the losses of energy will be six-fifths, four thirds and one respectively; the parabolic wire therefore takes a place intermediate between the other two.

Calculation for the Most Economical Cross-Section of a Wire. Gosselin. *Bul. Soc. Int. des Elec.*, July.—He assumes the case of a distant motor which is to be supplied with a certain amount of energy from a generating water-power station at which there is an excess of water-power, and he shows how to calculate the cross-section of the wire, which will give the minimum first cost of the whole installation. He deduces equations for the cost of the conductor and for the cost of the plant, each for various losses; the curves for these are then plotted and their ordinates added, which will give a third curve having a minimum point, and at this point the total cost will be the smallest.

Rules and Regulations. May. *Elek. Zeit.*, Sept. 24.—A reprint of the revised rules of the Union of the German Insurance Companies, with brief comparisons with the former, showing the changes.

Manufacture of Wire. Perrine. *Elec. Eng'ing*, October.—A continuation of his long serial (see *Digest*, Oct. 3). He discusses the formulas for the specific conductivity and specific weight, and more especially the insulation, dividing it into three different classes, giving brief descriptions of the various easy ways of insulating wire. Regarding stranded cables he states that the weight of the copper is found to be very nearly 3 per cent. greater than the "weight of the constituent wires," but owing to the absence of accurate determinations it is impossible to predict whether any stranded cable will have a conductivity varying appreciably from the equivalent solid wire; in the absence of experimental determinations it may be assumed that the resistance will not vary greatly from that of the equivalent solid wire.

ELECTRO-PHYSICS AND MAGNETISM.

Polarization in Alternating Currents. Wien. *Proc. Lond. Phys. Soc.*, August; abstracted from *Wied. Ann.*, 58, page 37.—A mathematical investigation of the subject of the periodic polarization of E. M. F. in a fluid cell through which an alternating current passes; it has been stated that such a cell could be substituted by a metallic resistance corresponding to the resistance of the cell, and by a condenser; as a result of his experiments he finds that this conclusion is not quite correct, and that the resistance is invariably higher than that calculated from the dimensions of the cell and from the conductivity of the liquid, and that therefore another resistance must be added to this.

Electric Currents Through Air. Lord Kelvin, Bottomley and McLean. *Lond. Elec.*, Sept. 25.—A brief extract of a B. A. paper on the measurement of electric currents through air at different densities; after describing the apparatus, they state that at the ordinary atmospheric density it requires 2000 to 3000 volts before any measurable current passes through 1.5 cm of air between two pointed terminals; as the difference of potential increases the current increases at a greater ratio; at 3000 volts it was 3.2 milliamperes and at 8000 volts 8.1; at lower densities the voltage necessary to start a current diminishes and at about 0.001 of the ordinary density it requires only "a few score of volts" to start a current.

Resistance of Bismuth. Fleming. Lond. *Elec.*, Sept. 25.—A foot note to his recent lecture (see *Digest*, July 4, 11 and 18) in which he states that since the delivery of the lecture he has been able, by the use of a powerful electromagnet, to increase the resistance of bismuth when cooled in liquid air, more than 150 times, by magnetizing it transversely in a field of 22,000 C. G. S. units.

Edison Effect in Glow Lamps. Fleming. *Proc. Lond. Phys. Soc.*, August.—The beginning of a reprint of his very long paper which was abstracted in the *Digest*, Sept. 25; it is continued but not concluded in the issue of September.

Electromagnetic Theory of Moving Charges. Morton. *Proc. Lond. Phys. Soc.*, August.—A reprint of the complete paper noticed in the *Digest*, June 27.

Cathode Rays. Puluj. *Proc. Lond. Phys. Soc.*, August.—A brief abstract of an article read March 13; he considers that the particles of matter torn from the cathode which convey the negative charges, equalize their charges on the glass walls, calling forth a disturbance of the material molecules and of their ether envelopes, each portion of the glass becoming a starting point of ether waves which, according to their character and period, are either visible phosphorescence or invisible Röntgen rays.

Permeability of Röntgen Rays. Ackroyd and Knowles. *Proc. Lond. Phys. Soc.*, August.—The discussion of a paper read March 13, in which they showed that the opacity increased with the molecular weight as distinguished from the atomic weight; Blakesley considered the Röntgen rays to be the propagation of an electrostatic strain through space.

Infra-Red and Röntgen Radiations. Nodon. *L'Elec.*, Sept. 26.—The beginning of an article on this subject, in the present portion of which he

discusses material and energy, the ether, refraction, polarization and similar subjects.

X-Ray Testing After Death. Lond. *Elec. Rev.*, Sept. 25.—A statement from an American photographic journal, that dead flesh offers more resistance to the rays than living, according to a Chicago physician.

Röntgen Rays. Proc. Lond. Phys. Soc., August.—A large number of abstracts, amounting to sixty-one, of various papers and articles on subjects connected with Röntgen rays, most of which have already been noticed in these columns.

Terrestrial Magnetism. FLEMING. Lond. *Elec.*, Sept. 25.—A note referring to a recent lecture, in which the statement is made that if the greater part of the earth's magnetism is due to permanently magnetized materials, then it is tolerably certain that this magnetic effect is wholly confined to a layer not much more than twelve miles thick.

Velocity of Electric Waves. SAUNDERS. *Phys. Rev.*, September-October.—A report of an investigation based on the phenomena of resonance; it is a direct method on the same principles as the one used recently by Trowbridge and Duane; the apparatus is described and illustrated, and the results are given in tables; the article includes a large number of references to articles on the subject of electric propagation; his final results give the values of the constant as 2.982 and 2.997.

Admittance and Impedence Loci. BEDELL. *Phys. Rev.*, September-October.—A reprint of his recent (London) Physical Society paper discussing the construction and application of such loci; for a given current for instance, they will give the various E. M. Fs. corresponding to changes in some part of the circuit; he applies this to transformers.

Induction Phenomena in Alternating-Current Circuits. MILLIS. *Phys. Rev.*, September-October.—A continuation of this article, the first part of which was noticed in the *Digest*, April 11; the present portion refers to charging and discharging of condensers and continuous charge and discharge, including a number of curves of the oscillations.

Visible Electric Waves. MOORE. *Phys. Rev.*, September-October.—A description of a method in which the wires were aglow with the electric waves, the whole presenting the appearance of circularly vibrating strings, thus showing the waves; the method is particularly serviceable for lecture purposes.

ELECTRO-CHEMISTRY AND BATTERIES.

Applied Electro-Chemistry. SWINBURNE. Lond. *Elec.* and *Elec. Eng.*, Sept. 25.—He discusses the calculation of the voltage required to cause decomposition, from the thermo-chemical data, and shows that great care must be taken not to use the wrong data; the thermo-chemical data is not always quoted intelligently, and it should therefore not be used blindly; such calculations should only be made by those who really understand what they are doing. As an illustration he supposes two like cells coupled in opposition, one of which is kept at a higher temperature, therefore generating a higher voltage and sending current through the other cell; in this case the voltage is not in accordance with the heats of the combination as the chemical action is the same in the two cells; as work is done, one of the cells must be taking heat from its surroundings; he deduces Helmholtz's equation, which shows that when a cell has a temperature coefficient the pressure does not follow the heats of combination, but depends on a temperature coefficient in a definite way. He then discusses the question of the seat of the E. M. F. of a cell, stating that notwithstanding the long discussion on this subject, his belief is that there is no such seat; as an analogy he shows that there is no seat of the so-called M. M. F., that is, no sudden rise of magnetic potential in the magnetic circuit, and he then applies the same argument to a ring-form electrical conductor in which a pressure is induced by magnetism; he considers the term E. M. F. as an unfortunate one when applied to the difference of potential instead of the rate of decrease of potential; furthermore permeability is really the analogue of specific inductive capacity; the term M. M. F. has unfortunately come to denote magnetic potential; "these absurdities have been approved by international and other congresses and committees, but the so-called work of holiday meetings of people with idle summers should not be taken too seriously." In the electric and magnetic circuits the potential is cyclic. He then discusses the subject of dissociation, giving a brief description of the electrolytic theory, as advocated by Nernst. In conclusion he gives a short, detailed account of the Ashcroft electrolytic process of treating the Broken Hill ores, which process he believes has never been described in print (it is being started in Australia and in the United States); it is used for the ores containing sulphide of lead and zinc, which are very troublesome to deal with. The ore is first ground and then roasted, after which it is leached with a solution containing persalts of iron and salts of zinc sulphates and chlorides; the solid matter then contains all the lead and some of the silver and zinc, and the solution is electrolyzed with iron anodes in a vat containing a diaphragm to keep the solution from mixing; the zinc is then deposited on the cathode; this is repeated to take out more of the zinc, after which the solution from the cathode chamber is placed in the anode chamber so as to take up more iron; it is then led to another chamber which has carbon anodes and converts the iron into ferric salts, which is then used for leaching the roasted ore, thus making a cyclic process.

Electricity Direct from Coal. Zeit. f. Elctrochemie, Sept. 20.—A long editorial review of the matter published on this subject recently by Jacques, Andrews and Reed. Regarding the device of the former, the opinion is expressed that practically it is an entirely worthless apparatus. Long tables are published, taken from an article by ANDREWS in *Industries and Iron*, June 26; references are given to experiments made with platinum and other metals in melted salts dating back to 1837, 1857 and 1881; the tables gave the values of the voltage between various metals in various cells, at different temperatures and after the lapse of successive intervals of time; the results show that the voltage often varies very greatly at high temperatures, with the time; it is also stated that they show that the effects are not thermo-electric alone, for without the electrolyte the difference of potential was very small; Andrews comes to a similar conclusion as Reed (see THE ELECTRICAL WORLD, July 15 and Aug. 8) but it is stated that neither have made a complete study of the subject.

Electrolysis of Gold. Lond. *Elec.*, Sept. 25.—A brief description of a modification of the Siemens & Halske process used in the Transvaal. The lead surface which receives the gold is formed of a thin detachable layer of lead foil, which, after receiving the deposit, is placed on an incline sheet of screening and heated just above its melting point so that the lead runs off, leaving the film of gold; much less lead is required, and the separation is therefore more easily effected.

Chlorine and Alkalies. BORCHERS. *Zeit. f. Electrochemie*, Sept. 20.—Tables giving the theoretical data for the electrolysis of chloride of sodium, and the data obtained in practice by the Castner and Kellner, the Hargreaves and Bird, and the Richardson and Holland processes, all reduced to one electrical horse-power for one year, working day and night; similar data is also given for the electrolysis of chloride of potassium.

Is Acetylene An Electrolyte? BREDIG and USOFF. *Zeit. f. Electrochemie*, Sept. 20.—A statement that acetylene is no doubt an exceedingly weak electrolyte, and also one of the weakest acids; free acetylene in solution in water cannot be split up appreciably by electrolysis, and is on the borderland between electrolytes and non-electrolytes.

Positive Plate for Accumulators. PERRY. Lond. *Elec.*, Sept. 25.—A brief communication referring to the life of the positive plates; he has had to do with various accumulators during the past six years, and his experience has shown him that one should recognize the comparatively short life of the positive plates and arrange for their constant renewal as a part of the regular routine; he suggests that each station should organize a shop for re-making plates on the premises. Editorially it is thought to be high time that the question should be settled whether the defects of accumulators are inherent or are capable of being remedied by mere alterations of construction which do not affect the chemistry of the cell.

Applied Electrochemistry. SWINBURNE. *Elty*, Oct. 7.—The beginning of a reprint of his Cantor lectures (see *Digest* last and this week).

UNITS, MEASUREMENTS AND INSTRUMENTS.

Variations in the E. M. F. of Clark Cells with Temperature. AYRTON and COOPER. *Proc. of the Roy. Soc.*, Vol. 59 (read Dec. 5, 1895).—The paper deals with the temperature variations and their effect upon the accuracy of this standard; much uncertainty has heretofore been felt as to the extent of the temperature correction according as the temperature variations are very slow or comparatively rapid, and the question arose as to whether one is justified in applying the correction in full; in the present paper the results of very extended tests are given with a view to furnishing information on the subject. The tests were begun more than two years ago; they were made with cells constructed according to the specifications of the Board of Trade; many of the results will hold good only for this class of cell and the modification induced by a large increase or decrease might be considerable. The standard cell for comparison was kept on ice and the other was heated; the results are given in a large number of curves. Some preliminary test experiments showed that the cells responded very readily to variations of temperature, and seemed to show that they reached a practically steady state after a few minutes, but these results were only approximate, and more accurate tests were therefore made; the method and apparatus are described; in general the method was to lower the temperature gradually and then increase it again, the curve of corresponding E. M. Fs. being then a loop, the normal direction being shown by a dotted line in the loop, and the lag being then represented by the distance between this dotted line and the lines forming the loop; a very large number of these curves are given "to avoid the formation of any erroneous conclusions"; the two parts of the loop are seldom parallel to the normal line; all the experiments tend to show that the lag, not including any semi-permanent lag, for that rate of variation of the temperature, does not as a rule exceed a quarter of an hour; the curves show that the lag generally has a different value for rising than for falling temperatures. Another set of experiments was made, in which the change was about two degrees up and down at the rate of one degree in 50 minutes, and it was found that lag was still evident although much diminished; the semi-permanent lag was strongly marked in some cases. They conclude that in general it appears that Clarke cells of this type are very sensitive to changes of temperature, but are subject to a lag which is variable in value even

when the changes are small, and for this reason it is generally impossible to apply a correction which shall be accurate to 0.0001 for even very slow variations of temperature; this is important only in dealing with comparisons. In a cell placed in a water bath, the temperature of which is 3 degrees different from the previous temperature, the lag for half an hour will not amount to more than 0.1 per cent., and will generally be less; in such cases the temperature coefficient should be diminished somewhat; a more suitable value for the temperature coefficient would result from such curves as those given, although it would not be the true value.

One-Volt Standard Cell. Lond. *Elec.*, Sept. 25.—In the discussion of the paper by Hibbert describing his one-volt standard cell (see *Digest*, July 25) before the B. A. meeting, the opinion was elicited from the author that it might be possible, though it would probably be difficult, to draw up a specification of the cell, such that a skilled person might set up a dozen cells which would not differ among themselves by more than one six-thousandth of a volt.

Lorenz Apparatus for Measuring Resistance. Lond. *Engineering*, Sept. 25.—An illustrated description of a recent form of the apparatus constructed for the McGill University, Montreal, for the absolute measurement of resistance.

Establishment of a National Physical Laboratory. Lond. *Elec.*, September; a reprint of the report of the B. A. Committee.—They show the importance of establishing a national laboratory like the German Reichsanstalt; the investigations of such a laboratory are divided into three classes: the observations of natural phenomena which must be prolonged through long periods, the testing and verification of instruments and the preservation of standards, and finally the systematic, accurate determination of physical constants and numerical data. They give a brief sketch of the functions and the management of such a laboratory and request the grant of $15,000 a year and an initial expenditure of $150,000; in an appendix they give the first cost and cost of operation of the Reichsanstalt, the first cost of which was nearly $1,000,000 and the annual expenses about $72,000.

New Method of Reading the Deflections of Galvanometers. Rice. *Amer. Jour. of Sc.*, October.—A description of a new method devised by Prof. Hastings of the Sheffield Scientific School; a galvanometer constructed on these principles has given very satisfactory results. The theory is briefly that if the linear dimensions of a Wiedemann gavanometer be sufficiently reduced, say n-fold, the sensitiveness would be increased n-fold, "while the accuracy of determination of duration would be decreased in the same ratio" since the apertures of the optical apparatus are thus reduced; if carried far enough the aperture of the telescope would be reduced to that of the pupil of the eye, and might therefore be dispensed with; in an irregular variable field such an instrument would be n times as accurate. The description given is as follows, which is accompanied by an illustration: "The magnet is a circular steel disc 1 cm in diameter polished on both sides for convenience, serving as a mirror, hung between two coils of wire with a silk suspension of about 5 cm. The coils are of No. 36 wire, with an outside diameter of 2.5 cm, and have a resistance each of 6 ohms. The brass covers which fit over the coils are provided with openings closed by glass so that there is a clear view of both faces of the magnet, while air currents are excluded. A small aperture of 1.4 mm diameter in the centre of the steel mirror permits a view of objects beyond, which lie sufficiently near the axis of the instrument. Facing the coil and the magnet within, but at a trifle higher level, is placed a small lens at a distance adjustable from 5 to 7 cm from the magnet. On the opposite side, at a similar adjustable distance from the mirror, is fixed a fine point, preferably of some dark material with a white background. Directly under the lens is a small scale. The image of this scale as formed by the mirror is seen superimposed upon the image of the fixed point as seen through the aperture in the mirror, and any change in the angular position of the mirror causes a relative shifting of these two images, which, under proper adjustment, are in the same plane and are therefore perfectly free from errors of parallax. The use of the lens serves the double purpose of reducing the linear dimensions of the apparatus and of giving such precision to the ocular accommodation that the edges of the hole in the magnet as well as the fixed image of the scale due to the glass windows are so far out of focus as to be quite invisible. When the lens point and small scale are once adjusted, the instrument is ready for use at any time with no further attention. If the support be moderately level, no leveling screws are necessary." With this galvanometer a potential of 0.00001 volt is readily detected and the sensitiveness is therefore sufficient for a large part of the elementary work of a laboratory; the simplicity and cheapness make it very desirable while its lack of delicacy is often of considerable importance. He suggests that this method of reading might be used with other galvanometers as a substitute for the telescope and long scale; it is much more accurate than the Thomson lamp and scale method.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Transmitting Signals with Hertzian Waves (Without Wires). Preece. ond. *Elec.*, Sept. 25.—In a discussion of a B. A. paper he stated that Marconi had transmitted signals in London to a distance of 1.25 miles by means of Hertzian waves reflected from one parabolic mirror to another, the receiving apparatus actuating a relay and producing Morse signals; further technical information is at present unobtainable. The Lond. *Elec. Eng.* states that a 10-inch induction coil was used with a Lodge originator and a parabolic reflector.

Rules for International Telegraph Service. Jour. Telegraphique, Sept. 25.—A complete set of the rules adopted at the recent conference at Buda Pest, published in the form of a supplement.

Telephone Statistics for 1894. Jour. Telegraphique, Sept. 25.—The annual telephone statistics of European and Asiatic countries.

Improvement in Dynamo Telegraphing. Medina. *Jour. of El'ty*, August.—The substitution of dynamos for the batteries in telegraphy, while a great improvement, was attended by impairment of the efficiency of quadruplex systems, and it considerably increased the vagueness in signaling. The dynamo system was adopted in 1894, in the San Francisco office, the dynamo being characterized by the large diameter of the commutator, which is larger than the armature, and the arrangement of the eight brushes, which are placed equally distantly on the surface of the commutator, thus giving different voltages for operating various lengths of telegraph circuits up to 1200 miles; since its introduction the trouble experienced with the quadruplex was carefully studied, with the result that it now works with greater efficiency than was formerly attained with chemical batteries; the present paper is devoted to a description of the improvements which have accomplished this result, the solution of the problem being in the application of a "continuity-preserving pole-changer," which was devised by the author, and is illustrated and described.

Telephone Situation. De Land. *Elec. Eng'ing*, October.—A short article showing that investors in the Bell interests need not feel alarmed regarding the competition, owing to the great experience which this company has had; he states that the new toll lines and small competing exchanges are the best advertiser of the Bell interests.

MISCELLANEOUS.

British Association Meeting. Lond. *Elec.*, Sept. 25.—A brief account of the proceedings of the recent Liverpool meeting, with brief mentions of the more important papers. There was quite a heated discussion on the subject of the nature of cathode and Röntgen rays, the English physicists taking one side and the German the other; the English physicists believe that Röntgen rays are essentially different in kind from cathode rays, while the Continental physicists believe that they are not; the former believe that cathode rays are a stream of electrified material particles, while the latter support the hypothesis of ether waves; Sir George Stokes regarded cathode rays as a stream of electrified material particles, while the Röntgen ray he believed to be etherial and due to one brief non-periodic impulse in the ether; Ruecker showed that Röntgen rays might be used for distinguishing between various qualities of porcelain, those containing phosphatic china being opaque relatively to those not containing this ingredient. The report of the meeting is followed by a list of the electrical papers read before the various sections.—The Lond. *Elec. Rev.*, Sept. 25, briefly reviews the discussion of the subject of Röntgen rays. Among other things it states that according to Lenard himself there were no Röntgen rays present in his original experiments and that only on one occasion had he obtained a slight indication of rays that were not deflected by a magnet.—Lond. *Engineering*, Sept. 25, begins a running account of the proceedings with abstracts of the papers.

British Association Meeting. Lond. *Elec. Eng.*, Sept. 18.—A reprint of the presidential address of Sir Joseph Lister, of Prof. J. J. Thomson and of Sir Douglas Fox; the latter is on engineering subjects, with a brief reference to electric railways.

International Congress of Applied Chemistry. Boistel. *L'Ind. Elec.*, Sept. 10.—A conclusion of the long report of the proceedings; abstracts are given of the papers on acetylene noticed in the *Digest*, Sept. 26. The next meeting is to be held in Vienna in 1898.

International Electrical Congress at Geneva. L'Ind. Elec., Sept. 10.—A continuation of the report of the proceedings; abstracts are given of the paper and discussion on the subject of disturbances on telephone lines due to alternating-currents (see *Digest*, Sept. 5) and on the protection of high tension lines against atmospheric discharges (see *Digest*, Sept. 12).

L'Elec., Sept. 19, publishes a continuation of the report of the proceedings, including brief abstracts of the papers.

Geneva Exhibition. Lond. *Elec. Rev.*, Sept. 18.—Illustrated descriptions of the exhibits of the Oerlikon Company.

Exhibition at Nuremberg. Wilking. *Elek. Anz.*, Sept. 10, 13 and 17.—An illustrated description of the electrical exhibits of this national exhibition.

National Exhibition at Nijni Novgorod, Russia. Zeit. f. Elek., Sept. 15.—A continuation of a description of the electrical exhibits.

Exhibition in Berlin. Elek. Anz., Sept. 17.—A continuation of the illustrated description of the electrical exhibits pertaining to signals.

Berlin Industrial Exhibition. MITTELMANN. *Elek. Zeit.*, Sept. 24.—The beginning of a descriptive report of the lighting and power apparatus at this exhibition.

Voltage Regulator for Thermopiles. Elek. Zeit., Sept. 24.—A reprint with illustrations of the article by Danneel, abstracted in the *Digest*, Sept. 26.

Magnetic Concentration. WEDDING. Lond. *Elec. Rev.*, Sept. 18.—An abstract of a paper noticed in the *Digest*, Oct. 3.

Biographical. Lond. *Elec.*, Sept. 17.—A full page steel portrait of J. J. Thomson, accompanied by a brief biography.

Educational. Canadian Elec. News, August.—A set of answers to the questions in an examination on electricity in the Toronto Technical School.

Technical Education in England and Germany. Lond. *Elec. Rev.*, Sept. 18.—A reprint of the recent discussion in the London *Times* (see Digest, Sept. 19).

Abstracts.—A number of recent papers on electrical subjects are abstracted in the *Abstracts of Papers in Foreign Transactions and Periodicals* published by the Institution of Civil Engineers, Vol. 125, No. 3. All of these have been abstracted in the *Digest*, but in most cases more briefly.

Journals.—The *Elektrotechnischer Anzeiger*, from the issue of July 12 to Sept. 10 was not received, and the articles in it were therefore not noticed in these columns.

British Association Meeting. Lond. *Elec. Eng.*, Sept. 18.—A reprint of the presidential address of Sir Joseph Lister, of Prof. J. J. Thomson and Sir Douglas Fox; the latter is on engineering subjects, with a brief reference to electric railways.

Proceedings of the American Association for the Advancement of Sciences. Science, Sept. 4.—A report of the proceedings of the recent meeting.

Science. Sept. 11.—A reprint in full of the address of the vice-president of Section D (Mechanical Science and Engineering) on "The Artistic Element in Engineering." A list is also given of the papers on physics, some of which are on electrical subjects; a brief synopsis is given of each paper.

Science. Oct. 2.—A reprint in full of the address of Vice-President Noyes of Section C (Chemistry), on "The Achievements of Physical Chemistry." It is followed by a long list of the papers read before that section, with a brief synopsis of each.

British Association Meeting. Science, Sept. 25.—A reprint in full of the address of President Lister, referring briefly to the medical application of Röntgen rays.

British Association Meeting. El'ty, Sept. 30.—An abstract of a number of papers which were read, some of which were noticed in last week's *Digest*; the others will be noticed when published in full; a reprint of the paper by BOESE on a complete apparatus for studying the properties of electric waves is begun.

Magnetic Plant. Elec. Eng., Sept. 30.—A brief note stating that an account is given in *Garden and Forest* of a plant which has the property of turning its leaves in a north and south direction; the younger leaves point more accurately than the older ones.

Biographical. Elec. Eng., Oct. 7, and *El'ty*, Sept. 30.—A reprint of the portrait and part of the biography of J. J. Thomson, noticed in the Digest last week.

Electricity in Naval Life. FISKE. *Elec. Eng.*, Oct. 7; a continuation of his serial.—The telephone is gradually making its way against the speaking-tube, it having the advantage of distinctness as against simplicity and less liability to get out of order; the telephone has not had a fair trial, "because it is comparatively recently that the long-distance solid-back transmitter has been introduced"; those who are acquainted with both this telephone and the speaking-tube prefer the former. For the transmission of orders visual signals are coming into use, which remain in evidence until replaced by another message. He refers briefly to an apparatus devised by him in which only unbroken circuits, varying in strength, are used, the object being to overcome difficulties due to metallic contacts in switches, which break the current.

The Possible and Impossible in Electric Development. BAXTER. *Eng. Mag.*, October.—He points out the difference between what is known to be possible and what is known to be impossible, and points out the absurdity of assertions as to the possibility of accomplishing many unheard-of things; in many cases it is known definitely that certain things can never be accomplished, such as perpetual motion, for instance; in other cases it is impossible to predict how near to perfection we may arrive in regard to theoretical possibilities; no one can say, for instance, that it will or will not be possible to perfect the storage battery for traction purposes; the question of the coal-consuming battery is briefly discussed, as pointed out in a recent paper of C. J. Reed. His arguments show that the line of demarcation between that which we know to be possible and that about which there is an uncertainty is not very far in advance of the actual accomplishments.

New Books.

ENGINEERING INDEX. Volume II. 1892–95. Edited by J. B. Johnson. Published by the "Engineering Magazine." Cloth, octavo. 474 pages. Price, $4.00.

The first volume of the "Engineering Index" appeared in 1892 and comprised the most important engineering literature to be found in the several current periodicals for the seven years previous. The present volume includes an index of engineering literature from 1892 to 1895 inclusive, and gives what the compiler believes to be the most important articles which appeared in the several engineering periodicals. The subject of the article, the paper in which it appeared, the date of issue, a sketch of the treatment and the name of the author are given in each case, the object being to present as briefly as possible to one searching for articles on particular subjects an idea of the character of the article and whether it would be advantageous to consult the original source.

The Index was started by the Association of Engineering Societies, but commencing with Jan. 1, 1896, will be carried on by the "Engineering Magazine." It attempts to cover all phases of engineering and is therefore necessarily confined to the most important articles. The result is that many omissions are made which to the interested searcher would prove of value. Although there is frequently more than one source given, yet we notice that where the same article has appeared in more than one periodical, but one is quoted, and that when another deserved mention from the standpoint of priority of publication. Instead of classifying several subjects each by itself, an alphabetical order is employed, thereby complicating the work as a source of ready reference. The Index is based upon worthy motives, and deserves the support of all interested in the literature pertaining to engineering progress.

ALTERNATING AND INTERRUPTED ELECTRIC CURRENTS. By Prof. George Forbes. Based upon three lectures delivered to the members of the Royal Institution. Biggs & Co., 139–140 Salisbury Court, Fleet Street, London, E. C. D. Van Nostrand Company, New York. 98 pages, 36 illustrations, Price $1.00.

The foundation and practically the entire construction of this book consists of three lectures delivered in the popular style before the Royal Institution, to unscientific but intelligent audiences. The author's name attached to this volume is sufficient to give it all the introduction that is necessary, still it may interest some to know a little of its treatment and the nature of its contents. In order to present to the reader a better conception of electrical phenomena the author bases his explanations on references to mechanical analogues. The submarine cable is treated of in the first lecture, one mechanical analogue of which is that of a heavy chain suspended at one end. By suddenly twisting the chain either backward or forward it does not rotate as a whole, due to its pliability, which corresponds to the capacity of an electrical circuit and also to inertia having for its electrical analogue, self-induction. The mechanical analogues for self and mutual induction are explained in a mechanical way, and include Maxwell's double-rotating pendulum. The danger of suddenly breaking a circuit having considerable self-induction and the danger of injuring the insulation is dwelt upon. Lag of current is illustrated, and some of Prof. Thomson's experiments with alternating-current magnets and the effects obtained from them are referred to and illustrated. The advantages of low frequencies, as compared with high frequencies, are considered. The volume concludes with explanations of electrical resonance and electrical oscillations.

To those desiring a mechanical conception of electrical phenomena, which is often helpful in studying an electrical problem, this book offers perhaps all that its author intended it should. Not much can be said for it aside from this. The contents were doubtless more interesting from a lecture standpoint than when presented in the present form.

Wooden Pipes for Electrical Conduits.

After repeated experiments with different kinds of woods for conduits, the Williamsport Wooden Pipe Company, Williamsport, Pa., has adopted the Pennsylvania yellow pine for such purposes, and the company has located its factory in the heart of 20,000 acres of this timber and connected the same with two railways.

In the manufacture of this conduit the log is sawed into squares at the mill. It is then run through a very large planer which surfaces the log on all sides at once, thereby making all pieces of uniform size and smoothness, all the sides being right angles. After the logs have been bored to the proper diameter they are treated with creosote by a special method which renders the wood perfectly moisture-proof and gives it a life of from 60 to 100 years. The creosote is specially prepared.

The work of manufacturing these pipes is under the personal supervision of Mr. J. M. Chesnut, a patentee, who is also superintendent of the works. The conduit as manufactured by this company gives a continuous smooth bore, with no jogs or ridges to interfere with the drawing in and out of cables, and the joints are said to be perfect. These conduits, it is claimed, offer a better protection to cables than any other class of underground pipes, and not being affected by moisture there is no danger of decay. Neither is it affected by frost, and it is claimed that the possibility of electrolysis is reduced to a minimum by the use of this pipe. It is stated that the conduit is laid down more easily and cheaply than iron, tile or fibre pipe because the joints are not screwed together and no cement or lead is used in making the joints.

Novelties in Miniature Lamps.

Some of the recent productions of the Standard Electric Lamp & Novelty Company, 248 West Twenty-third Street, New York, are illustrated herewith. The Standard ribbed lamp shown in Fig. 1 is made for direct or alternating current, of between 50 and 60 volts, and gives an illumination of eight candle-power. It is designed for mounting on candelabra bases and the ribs break up the light with a pleasing effect. They act as condensers, producing a stronger light along their lines. The rib lamp is also made spherical in form, the ribs being curved in conformity with the curved surface of the sphere. The filament in the latter lamp is in the form of a double coil.

Fig. 2 represents a telephone switchboard visual signal lamp and is very useful in telephone work for night service, enabling the operator to tell from a distance when a call has been received for a connection. The lamp shown in the illustration takes one tenth of an ampere at 20 volts.

A very useful design of lamp for decorative effects is shown in Fig. 3. This lamp has small lenses blown on the bulb, with the result that the light is condensed at these points. This style lamp is made with single, double and quadruple lenses, and they take from 2 to 20 volts according to the size, giving a light of from one half to six candle-power. Many

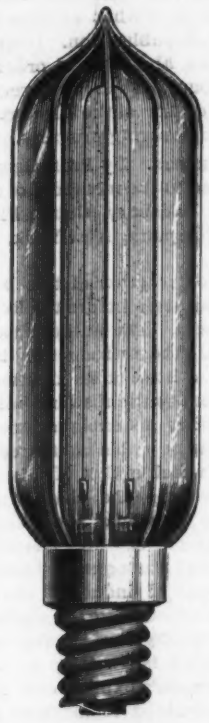


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

of these lamps are used as illuminants for microscopes and for stage effects, and the lenses can be made of colored glass, either ruby, blue or green.

In Fig. 4 is shown a lamp of new design which finds great use in surgical work. It is known as the Endoscope lamp, and is used largely in the examination of the throat and nose. On account of its shape it is readily adaptable for use in front of the speculum, and avoids the direct

Fig. 5.

Fig. 6.

rays of light falling on the eyes of the examiner. The filament, as will be seen, is circular in shape and concentric with a bulb. This shape of the bulb has an additional feature of value in that it acts as a lens and increases the power of the light as a consequence.

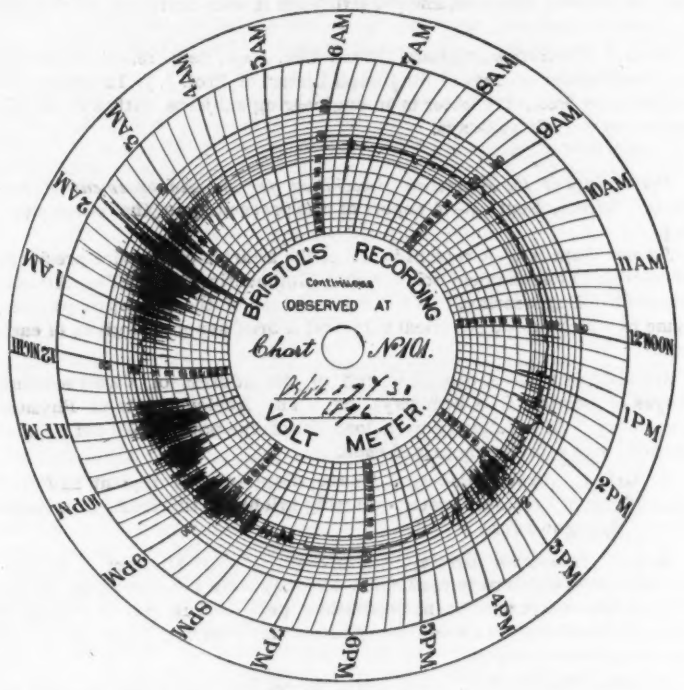
For scenic decorations Fig. 6 represents a beautiful design. The diadem is illuminated by lamps of various styles, which give prismatic effects. There are no less than 25 lamps in this crown, and they may be used in connection with batteries or other source of current. This device is said to be perfectly safe in use and this and other designs of this nature are already quite familiar to the theatre-going public. They produce startling and beautiful effects when worn by actresses.

In Fig. 5 is shown an American shield illuminated by miniature lamps, and any special explanation is hardly necessary—the design tells its own story. It is studded with 124 lamps, the lower half of the globes used for the stars being blue, those for the stripes being milk white and ruby.

The Standard Electric Lamp & Novelty Company is now engaged in the development of an incandescent searchlight of new design and construction which will soon be placed upon the market. It is also at work on a new Crookes tube for the production of Röntgen rays.

Operating Under Difficulties.

The accompanying chart represents partially the conditions under which the Edison Electric Illuminating Company, of Williamsport, Pa., was operating on the night of Sept. 29 and the morning of Sept. 30. Williamsport on the above dates experienced a severe storm, the wind blowing at about 70 miles an hour. On the morning of the 30th it was found that 17 poles had been blown down and there existed 49 crosses due to trees and wires lying on the ground. The plant had been operated throughout the entire storm without once stopping. Although consumers were favored with electrical supply it is questionable, judging from the voltmeter readings, whether darkness or electric lights was preferable.



Voltage Chart.

Röntgen-Ray Apparatus.

The Edison Decorative & Miniature Lamp Department, General Electric Company, Harrison, N. J., is now placing on the market some apparatus for the production and observation of Röntgen rays. The instruments are of the most modern and improved pattern, their forms having been established after a long series of experiments for the determination of the conditions for the production of the best results. Each piece of apparatus has been improved in every way possible to secure reliable action, and our readers will no doubt be interested in a brief description of a few of the devices.

In Fig. 1 is shown a view of a Thomson inductorium. This instrument gives a constant stream of working sparks six inches in length. The coil is carefully wound and insulated to a very high degree, and to provide additional insulation it is placed in a substantial wooden box which is intended to be filled with oil. The connections are all effected on the outside of the box, and the condenser and contact-breaker are entirely separate from the inductorium box. The contact-breaker is of the rotary type, and operated by a small motor which forms part of the equipment of the coil. The inductorium is calculated to fill almost all requirements of physicians and surgeons for ordinary practice. In connection with either the Thomson double focus tube or the single focus tube, a very clear and distinct fluoroscopic examination can be made of the limbs and extremities, and to a considerable extent, of the human trunk. Some sizes of the inducto-

rium may be used with primary or secondary batteries or upon electric light circuits, either of the direct or alternating current systems.

A Röntgen ray static machine of the Holtz-Toepler type is shown in

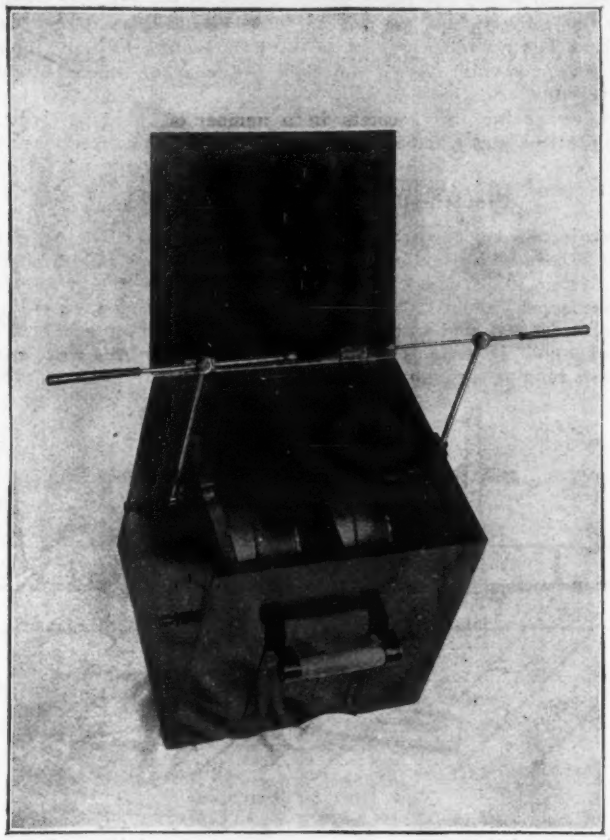


FIG. 1.

Fig. 2. This instrument has been modified and improved as the most recent practical experience and knowledge have suggested.

These machines are so constructed that they may be driven by hand power or by a small motor deriving its power from electricity, gas or water. The various parts of the machine are constructed with the best materials and assembled in a very careful manner. The metallic parts are substantially made and of high finish, and the Leyden jars are made of specially selected glass and will discharge quickly.

Fig. 3 illustrates the Thomson universal double-focus tube, which is one of the various styles made by the company for Röntgen-ray work. This tube was devised by Prof. Elihu Thomson after considerable experimentation, and as its name indicates, is intended for universal use. It has three electrodes, two of which are concave in shape. These are

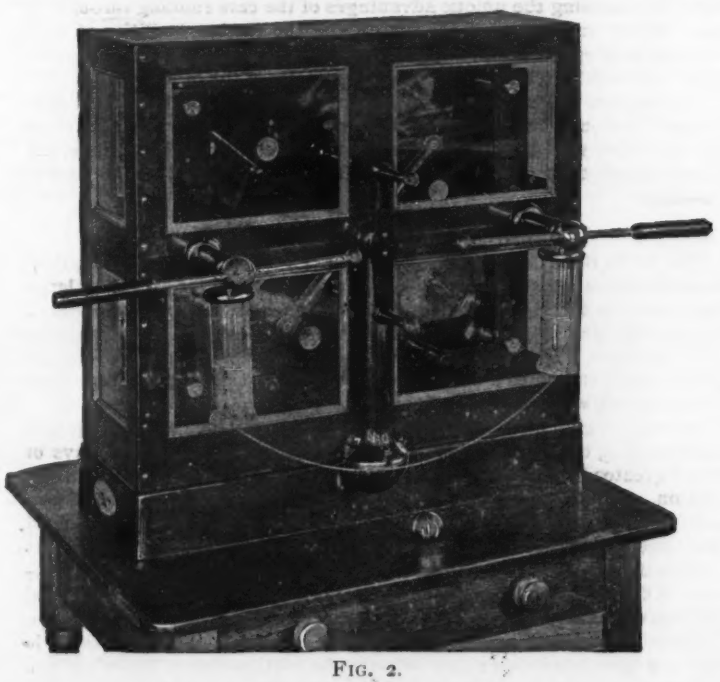


FIG. 2.

made of aluminum, the third electrode, which is wedge-shaped and located in the centre of the tube, being made of platinum. In practice the concave cups are intended to be used as cathode electrodes. The cathodic rays are focused upon the platinum wedge-shaped anode, thereby producing X-rays. This type of tube, it is stated, gives a sharp definition of objects examined or radiographed and has met with extensive approbation and use. The vacuum tubes are provided with an adjustable vacuum feature which enables the operator to readily bring the vacuum down to the point of usefulness when it has become high from continued use. This tube may be successfully used on Ruhmkorff coils and the Thomson inductorium, and is especially adaptable to the Thomson Röntgen-ray transformer or any other high-frequency apparatus. It may also be successfully used in connection with static machines.

All of the exciting apparatus manufactured by this company is made under the personal direction of Prof. Elihu Thomson, and the vacuum

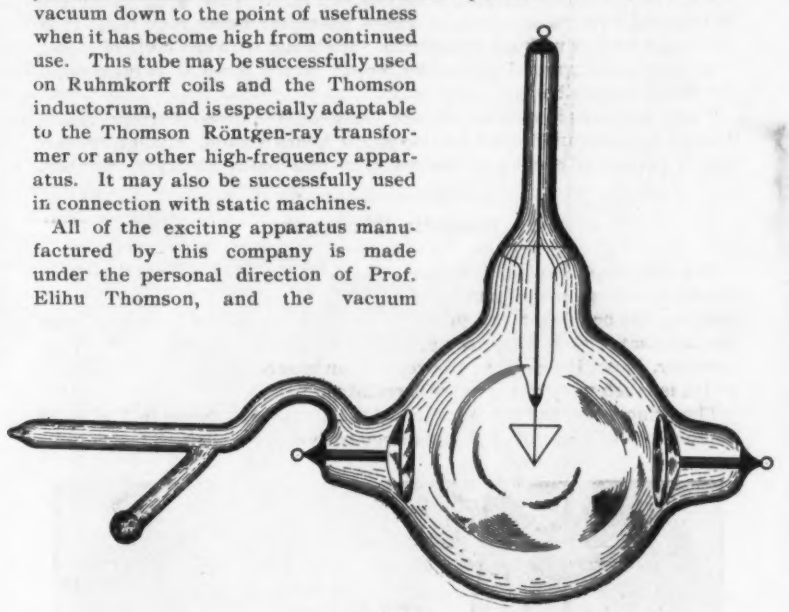


FIG. 3.

tubes are made at the lamp works of the General Electric Company at Harrison, N. J., under the supervision of experienced operators in this class of work.

Some New Designs in Arc Lamps.

The Electric Arc Light Company, New York, is placing on the market four new designs of "Pioneer" long-hour arc lamps, which embody some notable features and improvements in beauty of outline and detail of finish.

FIG. 1.

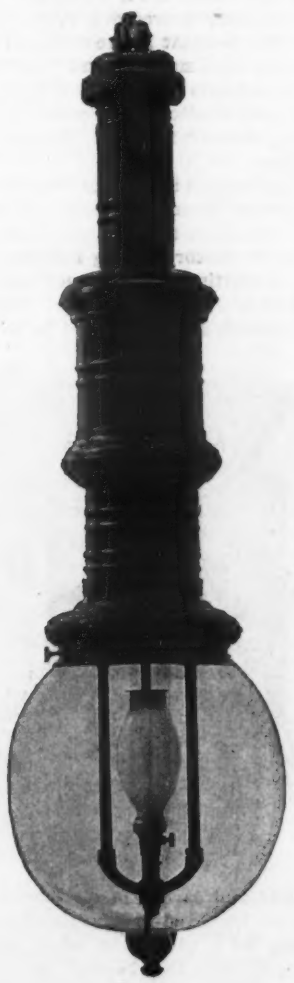


FIG. 2.

Fig. 1 represents a Pioneer standard indoor lamp, style C. It is 37 inches in length and is finished in polished brass. Three decorative bands, embossed with black background, give the lamp a very beautiful

appearance. The globe is light opal. The upper carbon is $\frac{7}{16}$ inches in diameter by 10 inches long, and the lower $\frac{7}{8}$ by 4¾. The company makes another lamp of this style 4 inches longer. The style C lamp is designed for rooms with comparatively low ceilings, and this shortening slightly reduces the life of the carbons.

The outdoor lamp, style E, is shown in Fig. 2. This lamp is of the waterproof pattern, no hood or storm protector being required. It is furnished with or without ornamental scrolls and with any style of globe, clear, light opal, ground, etc. The length of the lamp is 41 inches and the finish is dead black.

These lamps, as is well known, are designed for direct current incandescent circuits, and burn from 100 to 150 hours without change of carbon by reason of enclosing the arc in a practically air-tight chamber.

Graphite Rheostats.

The Graphite Rheostat Company, Chicago, Ill., has for some time been known as a large manufacturer of graphite rheostats. The popular supposition has been that the principle of these rheostats depended upon the fact that carbon when compressed diminishes in resistance. This, however, is not the case, as the regulation is accomplished by a method which is much more uniform in its results.

The principle of the construction of the rheostat is shown in Fig. 1. A number of cylinders of high-resistance carbon are made hollow, through

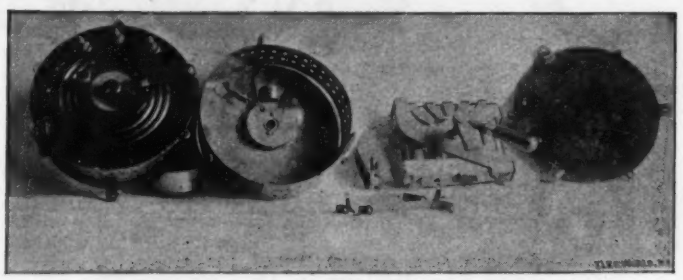


Fig. 1.

which run steel rods which can be inserted to any desired length by means of a handle. The principle, therefore, is that a longer or shorter length of the carbon is in circuit. The resistance of this carbon may be varied to any desired degree by varying its composition.

Such a rheostat as the one shown may have all its cylinders connected in series or in multiple, and thus adjust its capacity to a number of different voltages. The effect of this mechanism is to produce an absolutely uniform gradation of the resistance and consequently of the current flow. It is equivalent to a wire rheostat with an infinite number of contact points.

This rheostat is used for theatre dimmers, field rheostats and rheostats for electro-therapeutic and cautery work.

An ingenious application of this device is shown in Fig. 2, which illustrates the motor-starting rheostat. This rheostat is merely for the purpose of starting, and does not need the fine gradation that is required on field or dimmer rheostats. This point is taken advantage of and the gradation is simply effected by five contact points controlling as many

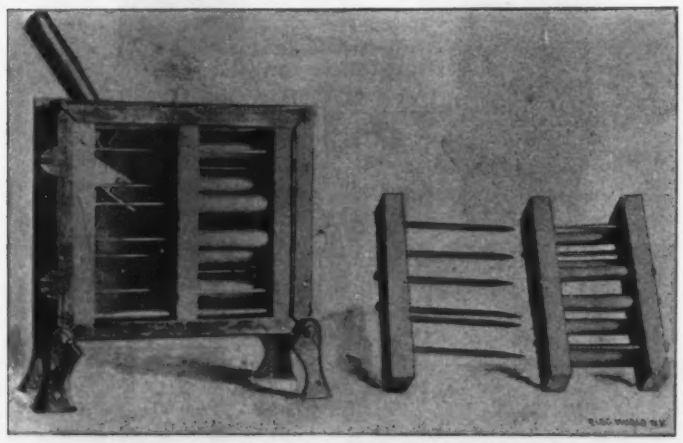


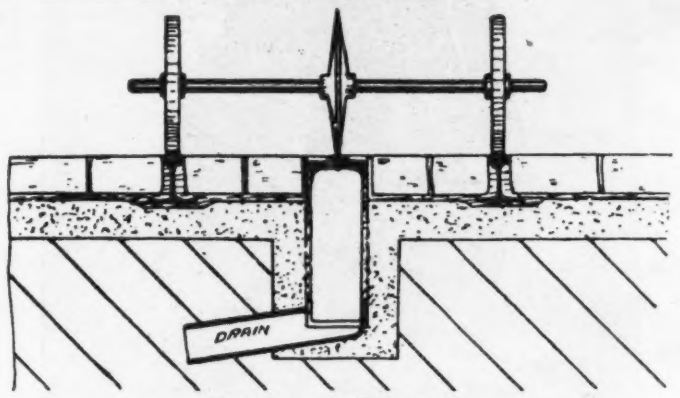
Fig. 2.

cylinders of carbon in series with one another. These cylinders of carbon are mounted in an incombustible box of metal or soapstone and swung on a pivot, the whole being counterweighted so that gravity tends to shut the rheostat off altogether. As the handle is pressed downward, the contact in the base of the block slides over the contacts on the movable portion and the motor starts. When the handle is pressed around to its limit, the lug which impinges against the lever is highly magnetized by a bobbin in series with the shunt field surrounding it. This holds the rheostat shut. If for any reason the line should fail, the motor would continue to run by its own momentum as a generator and as it slowed down its field would gradually weaken until a point was reached where the magnetizing bobbin on the rheostat would become too feeble to hold the rheostat closed when it would fall open by gravity. The motor is thus shut down by an ideal method, and the fields have no opportunity to give a vicious discharge, which is liable to puncture the insulation.

Besides making its rheostats in a number of standard forms, the Graphite Rheostat Company is prepared to make them from special designs.

Electrically Driven Cable Railways.

What is called a new system of electrically driven cable railways is being introduced in England by Messrs. Meacock Bros., of Birmingham. This system as patented, consists of forming the cable in single continuous loops of about 1½ miles long, which pass around a fixed guide pulley at one end, and around a combined driving and tension pulley at the other end. The loops overlap each other, and in this way facilitate the cars running through on all the routes.



New Idea in Railways.

It is claimed that fouling of pipes under the track is avoided by the central plain continuous-slot trough, being only 22 inches deep. The top of the trough is serrated and a non-slipping surface is so secured.

It is thought that as grooves in the rails are dispensed with the road surface is improved, while at the same time the durability of the rails is increased, the repairs to track lessened, and the noise of car propulsion reduced. The car is guided by a central disc wheel secured upon the axis, and the flanges of the rail wheels are dispensed with. Electric motors fixed in duplicate upon the tension carriage operate the cable. It is claimed that direct electrical driving will give greater steadiness, higher efficiency and freedom from noise, and it is further said that the system facilitates the working of the complete routes of any district from a central power-station with all the economy of first cost and working expenses accruing from power centralization. This system is applicable to single or double track routes, and the capital outlay required to install the same is said to be considerably less than present systems, besides possessing the unique advantages of the cars running through on any desired number, or all the routes, and the further facilities of easy regulation of speed to suit any particular district through which the cars may run, each loop being driven independently of the other.

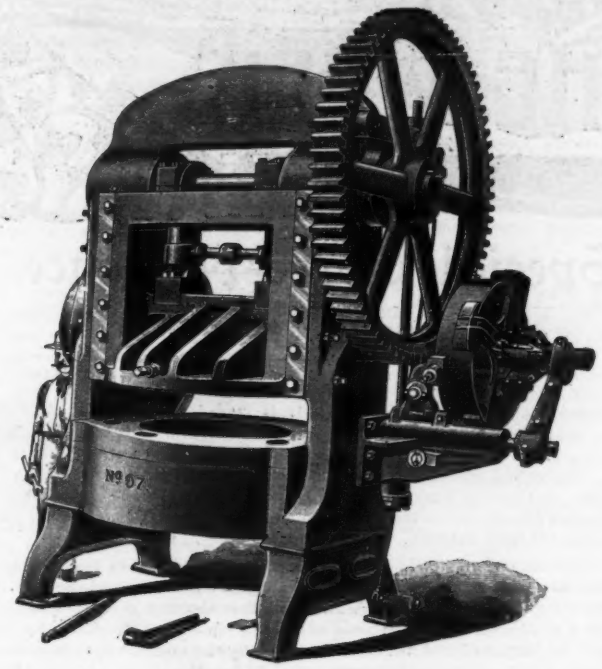
This system has not, as far as known, been put to practical test anywhere. It would be interesting to know whether any practical runs at all have been made, for unless something of the kind has been done, the great claims they are making when introducing it are by no means justified.

Press for Large Armature Discs.

The E. W. Bliss Company, Brooklyn, N. Y., has designed for electrical manufacturers a machine which is especially adapted for operating large and accurate cutting and perforating dies, such as are extensively used in the manufacture of armature discs and sections for electric motors and dynamos. The accompanying illustration shows a view of this press, which embodies a number of special features not heretofore used in connection with machines of this class.

In order to give a firm support and accurate guidance to the large and delicate dies, the ordinary centre gib has been abandoned, and ways of much greater length and width substituted, as will be seen in the illustration. Another special feature is the application to this press of a new automatic friction clutch, which obviates the difficulties experienced with the positive automatic clutch on heavy back-geared presses. Its application and construction will be understood from the cut. A pressure of the foot treadle releases a weight which actuates the powerful friction clutch on the back shaft, thus starting the press almost instantaneously and obviating entirely severe shock. After the shaft has made one complete revolution a cam releases the friction clutch, throwing into action at the same time a brake and thus stopping the slide at the highest point of the stroke. The large gear wheel instead of revolving continu-

ally is, with these new clutches, keyed on to the shaft and is at a standstill until the clutch is thrown into action. This constitutes an additional advantage in the saving of considerable wear on the shaft and wheel hub. The press described is for the very largest sizes of armature blanks and weighs 25,000 pounds. It will blank a disc 48 inches in diameter, but it may be modified to take even larger sizes.



ARMATURE DISC PRESS.

The Porter-Allen Engine.

The Southwark Foundry & Machine Company, Philadelphia, Pa., is the manufacturer of the well-known high-grade Porter-Allen engine. Almost every engineer has seen this engine; a great many have run it, and not a few are familiar with its entire construction. For the benefit of those who are not thoroughly acquainted with the design we submit herewith diagrams and data descriptive of its chief features. Fig. 1, which is a general view of the engine, shows as one of its most prominent features the overhung cylinder held to the engine bed by bolts and supported by a hood which forms part of the bed casting, allowing thus of free expansion and contraction with variations in temperature.

The cylinders are quite short, thus avoiding, as claimed by the makers, the flexibility which is inherent to those of greater length. The clearance, which is very small in proportion to the piston displacement, is neutralized by compression, the same being carried up to the initial pressure of the steam, and remaining constant under all changes of load.

Fig. 2 gives an excellent idea of the arrangement of the valves, of which there are four, two for admission and two for exhaust. The valves are balanced by pressure plates, as shown in Fig. 3. Each admission pressure plate may be lifted from the valve by means of a screw and check nut, and the plate may be adjusted to exactly the amount necessary to prevent leakage, thus reducing the friction to a minimum. The valves are very light, and each opens its port simultaneously at four openings, as shown by the arrows in Fig. 2. The pull of the valve rod on the valve is central, so that unequal wear is entirely avoided, and by a simple adjustment of the screw *d*, shown in Fig. 3, the engineer may keep it permanently tight. The pressure plates carrying with them the valve will be lifted from the valve seat whenever the pressure in the cylinder exceeds that of the valve chest, so that no water which the cylinder may contain can do damage.

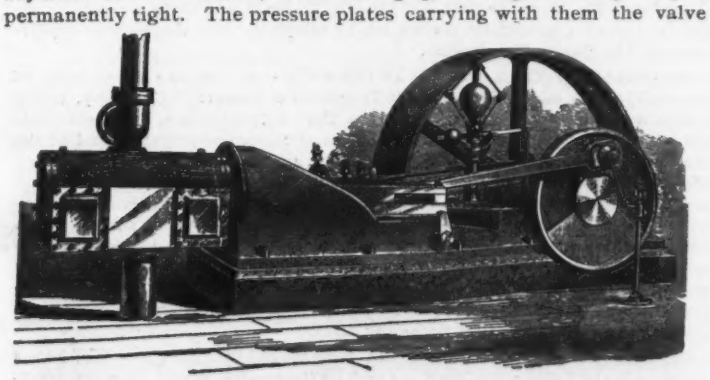


FIG. 1.

The valve-gear mechanism is quite a distinctive feature of this engine. The eccentric is shown in Fig. 4 in side and front elevations. It is very short and carries a link in which the eccentric rod is caused to slide up and down by the governor rod, so that the duration of admission of steam is changed with the change of load. The eccentric strap is pivoted to a rocking lever, thus giving it a definite motion with every revolution, while the eccentric itself is forged solid with the shaft.

The essential moving parts of the governor can be oiled and inspected at any time, which is an impossibility with a fly-wheel type of governor. The rocking lever which supports the eccentric is pivoted to the engine bed. The radius of the link is equal to the length of the rod which communicates its motion to the valves. In all reciprocating engines the angular oscillation of the connecting rod causes considerable irregularity in the motion of the piston at the opposite ends of the cylinder, being retarded at the end nearest to the crank and accelerated at the end furthest from it. In the Porter-Allen engine, however, the driving-arm of the link is of such a length that its angular oscillation corresponds in degree as well as in time with that of the connecting rod, so that the valves are accelerated and retarded without any irregularity of the piston motion, an important advantage not commonly found in other types of high-speed engines.

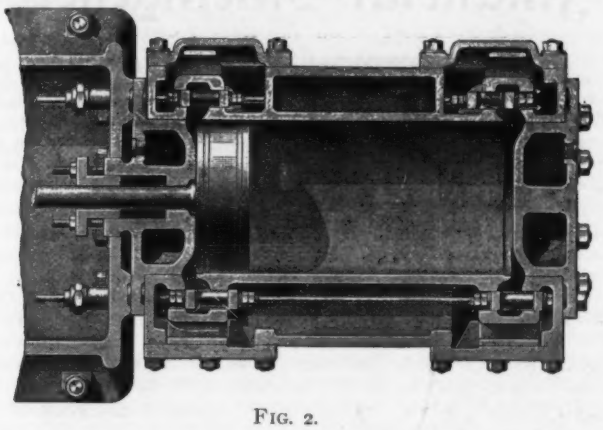


FIG. 2.

The exhaust valves are positively connected by a rod to the end of the link, while the admission valves are driven by a block sliding in the link as previously stated. The hook rod can be disconnected from the pin, thus enabling the valves to be worked by hand.

The governor shown in Fig. 1 is a unique feature of the Porter-Allen engine. It is extremely powerful and at the same time positive in its motions. Its speed is constant, and by simply changing the pulley the same governor can be adapted to any engine. The Southwark Foundry & Machine Company manufactures and sells these governors separately.

The engine bed is extremely rigid and sufficiently strong to overcome all vibrations, a feature to which the company ascribes the uniformly cool bearings. Wedges and screws are used to tighten the main bearing, which is of the quarter box type. All bearings are of liberal dimensions, so as to reduce the pressure on the wearing surfaces well within the carrying capacity of lubricating oils.

After the fly-wheel had been bored to the exact size of the shaft, the hole is then slightly turned off on the key side, and the first impression would be that this would result in a very bad fit, but after the key has been put in place it will be found that the wheel is very firmly and accurately fitted. As a matter of fact all fly-wheel shafts which drive fly-wheels by means of a tapered key have a slight crescent on the key side and bear on the shaft only on the side opposite the key. In this engine advantage has been taken of this fact so that the crescent is made a little larger for convenience in assembling.

The valve-gear joints consist of hardened steel pins working in hardened steel bushings which are made truly cylindrical and ground to a fit.

The lubrication is automatic and continuous, the cups being stationary and capable of being filled while the engine is running.

Owing to the high speed of these engines a very much smaller fly-wheel can take care of the variable load and the action of the reciprocating parts is such as to assist in making the motion more uniform. The condensation in the engine cylinders is smaller per pound of steam than in most types. The several valves which the Porter-Allen engine possesses and the flexibility of the valve setting ensures a superior steam distribution. The engine is built in vertical and horizontal sizes both simple and compound, and varying from 45 to 3000 horse-power.

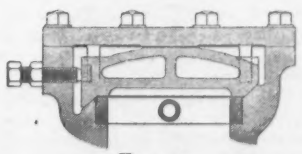


FIG. 3.

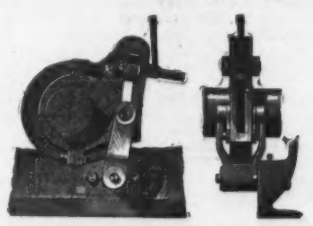


FIG. 4.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Oct. 10, 1896.

ELECTRICAL STOCKS.—The market for these securities has been characterized by extreme dullness, with downward tendencies. All of the prominent stocks have suffered declines. General Electric closed the week with a net loss of three points, on a volume of business below the average. Electric Storage Battery quotations dropped off about three points.

TELEGRAPH AND TELEPHONE.—There was general dullness in these classes of securities, prices tending downward. Western Union lost one and one eighth points on the week's business, the number of shares sold being 11,192. Bell Telephone closed at 203 bid, which is a loss of one point as compared with the closing quotation of the previous week. Erie Telephone advanced one point.

TRACTIONS.—The market for street railway securities continues dull and featureless, and quotations generally have suffered fractional losses.

GRAND HAVEN, MICH.—The citizens have voted to issue $10,000 in bonds to build an electric light plant.

CAMERON, MO.—The city has voted to issue $18,000 in bonds for the construction of a system of electric lighting.

THE COLUMBUS STREET RAILWAY COMPANY reports gross earnings for September of $56,883, a decrease of $8917, as compared with the same month of last year, and net $31,729, a decrease of $6454.

EATON RAPIDS, MICH.—At a recent election the proposition to issue $8000 bonds for the construction of an electric light plant was carried, but as yet no purchasers for the bonds have been found.

FINANCIAL REPORTS.—The New Orleans Traction Company reports gross earnings for September of $107,839, a decrease of $5477, as compared with the same month of last year, and net $45,923, an increase of $6404.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	..	..
Edison Electric Ill., New York	100	92	95
" " " Brooklyn	100	88	93
" " " Boston	100	..	..
" " " Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	26	6½
Electric Storage, pref	100	28	30
General Electric	100	25⅞	26
General Electric, pref	100	64	67
Westinghouse Consolidated, com	50	23	23½
" " pref	50	49½	50

BONDS.

Edison Electric Ill., New York	105	95⅝	100
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	88½	..

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	203	..
American District Telegraph	100	*29	39
American Telegraph & Cable	100	90	91½
Central & South American Telegraph	100	124	127
Commercial Cables	100	140	..
Erie Telephone	100	59	..
New England Telephone	100	90	..
Postal Telegraph-Cable	100	78	80
Western Union Telegraph	100	81¾	82

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	16¾	17
Brooklyn Rapid Transit		19¾	20¼
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	65	67
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	41	43
Hestonville	100	48	48½
" pref		..	62½
New Orleans Traction	100	5	7
" " pref	100	..	50
North Shore Traction	100	20	23
" " pref	100	71	74
Rochester St. Ry	..	15	20
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	103
Union Traction, rcts $10 pd	..	12½	13
West End, Boston	100	67¼	..
" " pref	100	89¾	..
Worcester Traction	100	15	18
" " pref	100	85	88

BONDS.

Brooklyn Rapid Transit 5s. 1945	100	76	..
Buffalo St. Ry. 1st con. 5s	100	..	*104
Cleveland Elec. Ry. 1st mtge 5s	100	100	*103
*Columbus St. Ry. 1st 5s	100	90	*95
Rochester St. Ry. 1st 5s	100	..	98
Union Railway (Huckleberry) 1st mtge 5s		100	*103
*Westchester Electric 1st mtge 5s	100	100	103

* With accrued interest.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Oct. 11, 1896.

KINGSBRIDGE TROLLEY LINE.—It is stated that the Third Avenue Railway Company will commence equipping the new line from Manhattan Street to 165th Street, thence along Kingsbridge Road to the northern city limits. The trolley system is to be introduced on that section of the line from 162d Street to the city limits, but the method of traction below 162d Street to Manhattan Street and on the St. Nicholas Avenue and Forty-second Street line has not yet been decided.

THE ERICSSON TELEPHONE COMPANY.—Referring to the paragraph in our last issue concerning the Ericsson Telephone Company, of this city, that company informs us that the Ericsson Swedish coal-grain microphone transmitter that will be used in connection with the telephone of the company's own make, will be imported and not manufactured by the company, as was stated. The company will sell its instruments outright, and will do no construction work whatever. It will manufacture a full line of telephones, for long and short distance, desk, interior and inter-communicating systems. The company's offices are in the Home Insurance Building.

EDISON X-RAY APPARATUS.—We learn that the Edison Manufacturing Company is now placing on the market a complete line of Mr. Edison's Röntgen-ray apparatus. The company is prepared to supply a range of outfits operated by battery power and also the special high-speed break wheel equipment, operated by the Edison current as exhibited by Mr. Edison at the recent electrical show in New York City. No genuine Edison apparatus has up to the present time been sold, as we understand that Mr. Edison wished to bring this apparatus to a high degree of perfection before allowing it to be placed on the market. The Edison laboratory now has a staff of men employed in making Edison X-ray focus tubes, all of which are manufactured under Mr. Edison's personal supervision.

THE ST. LOUIS CONVENTION.—The H. W. Johns Manufacturing Company will show in its exhibit at the St. Louis Convention the various styles of its "H. W. J." car heaters. A car on exhibition in the space of the American Car Company will be equipped with the heaters in full operation, giving an opportunity for inspecting the "H. W. J." system of car heating. The company will exhibit in its space various styles of its car heaters in operation, and will also display its moulded mica trolley line insulating materials and vulcabeston in a variety of shapes for electrical purposes. The company will be represented by J. Emory Meek, from New York; J. W. Perry, from Philadelphia; H. A. Reeves, from Chicago; and E. B. Hatch and Herbert Luscomb, of the Johns-Pratt Company, Hartford, Conn., and J. H. MacLennan, of St. Louis.

SUBMARINE CABLES IN NEW YORK BAY.—W. R. Brixey, New York, has recently constructed and laid a special "Kerite" submarine cable for telephone purposes, connecting Swinburne Island and Hoffman Island with Staten Island. The work was carried out under the direction of the Quarantine Commissioners. The cable will give Swinburne and Hoffman Island direct communication with the health officer at Quarantine Station on Staten Island and with the long-distance telephone service. These cables, which are now in use, were specially constructed by the Kerite people and laid under their supervision. It is said that they constitute the longest submarine telephone connection in the United States. The length of the cables is about three and one half miles. This improvement will give the Quarantine Commissioners excellent facilities for immediate connection by telephone with the several departments of the Quarantine service.

DRAWBAUGH TELEPHONE INTERESTS.—At the annual meeting of the stockholders of the Drawbaugh Telephone & Telegraph Company, which was held at the company's offices in New York City on Oct. 6, President Bartlett in his report set forth the present status of telephone litigation and of the Government suit against the Bell Company, and stated that the Drawbaugh case was practically reopened by the last suit. He said that the United States Senate would probably act favorably upon the report of the Senate Patent Committee to the Drawbaugh bill, and that in the event of such action the entire question of the Drawbaugh claims would be reopened in spite of the recent action of the Court of Appeals of the District of Columbia. This court he stated appears to have adopted the decision of the Supreme Court of the United States, rendered in 1888, as finally settling all questions against Drawbaugh that could at any time hereafter arise.

MESSRS. A. K. WARREN & CO. have moved into their new permanent quarters in the Trinity Building, 451 and 453 Greenwich Street, opposite their temporary premises in Desbrosses Street. Mr. Warren and his partner, Mr. James Rich Steers, are much pleased with the new place of business, from the fact that the shop, store and offices are all on one large ground floor, greatly facilitating the handling of heavy machinery, which, in repair, constitutes the main part of the firm's business. Messrs. Warren and Steers also say that their contract department for maintaining electric plants has met with such success that they have had to engage additional experienced help to keep up with the demand for inspections. A visit to their stores will demonstrate to users of

electrical machinery the complete system in use for handling emergency or breakdown work, which is now reduced to a science. Their telephone, 881 Franklin, is open night and day for calls on this class of work.

TELEGRAPHY IN A DRAMA.—In the new war drama, "Secret Service," now running at the Garrick Theatre, New York, telegraphy plays an important part. The scene of "Secret Service" is laid in Richmond, Va., while that city was besieged by the Union forces. The hero, whose part is taken by the author, William Gillette, is *Lewis Dumont*, a member of the United States Secret Service, and an expert telegrapher, who is known in Richmond as *Captain Thorne* of the Confederate army. The scene of the third act is in the Confederate War Department telegraph office, where the so-called *Captain Thorne*, with forged orders placing him in charge of the office, undertakes to send a false dispatch intended to weaken the Confederate lines before Richmond, so as to facilitate a Federal attack. The usual complications arise, however, and before he has sent the dispatch, his true character is discovered. The wires, batteries and ticking instruments make a realistic stage picture, which will prove of especial interest to electricians.

THE E. S. GREELEY & CO. FINANCIALLY EMBARRASSED.—On Oct. 7 the United States Circuit Court, on the application of a majority of the directors of the company, appointed Gen. E. S. Greeley, the president, and Mr. James W. Sands, the secretary, receivers of The E. S. Greeley & Co. of this city and New Haven, Conn. Although for the last year or so the company has been so slow in its payments that some of the more conservative houses declined to extend its credit, the appointment of receivers was a surprise to the trade. It is said that until after the receivers had been appointed and qualified even, Mr. T. J. Smith, manager of the company's electrical department and the fourth largest stockholder, was unaware that any such course was contemplated. The difficulty in making collections and in meeting obligations had become so great, however, that Gen. Greeley, who owns about two-thirds of the stock of the company, decided not to invest any more money in the business, but to wind it up, accepting his loss as it now stands, and quit. Some of the larger creditors have suggested that if Mr. Smith could raise sufficient capital to purchase the assets from the receivers and reorganize the company, they would be willing to accept the obligations of the new corporation for the indebtedness due them. The General and his associates have the warm sympathy of all who know them. The E. S. Greeley & Co. is one of the oldest electrical supply houses in the United States. The business was established more than 40 years ago, by the late Mr. L. G. Tillotson, and until within 12 years was carried on under the firm name of L. G. Tillotson & Co. Gen. Greeley, whose early training had been in connection with steam railways at New Haven, Conn., and who had won fame and title during the war, became a partner in 1865, when in addition to electrical apparatus the firm began also to handle railway supplies. On the death of Mr. Tillotson in 1884 Gen. Greeley succeeded to the business, the firm name then being changed to E. S. Greeley & Co. In 1887 the business was incorporated under the Connecticut laws, which have the rather absurd provision that the title of all such corporations must begin with the word "The" and end with the word "Company." This explains why the firm has had to struggle along for nearly a decade under the awkward appellation of "The E. S. Greeley & Co." The liabilities of the company are stated to be $160,000, of which $65,000 is for merchandise and $70,000 due on notes. The assets are given at $180,000, consisting of accounts receivable $125,000; merchandise $40,000, contents of factory $15,000, cash $100. The assets in Connecticut are $500 in office furniture. It must be of pathetic interest for Gen. Greeley to recall at this time the opportunity which he and Mr. Tillotson in their conservatism allowed to go unimproved in 1877 of making princely fortunes out of the then recently patented Bell telephone. The proposition made by the owners of the Bell patents was that if the firm of L. G. Tillotson & Co. would manufacture for the Bell Company telephones to the value of $50,000 this amount would be paid in cash out of the first receipts of the company, and as an inducement to extend this credit the firm of L. G. Tillotson & Co. would be given one quarter of the stock of the Bell Company. Both Mr. Tillotson and Gen. Greeley were far-seeing business men, but in those early days the telephone switchboard had not been suggested, and they could not figure out a sale for telephones for private lines, even at $4 or $5 a set, sufficient to warrant an investment of $50,000. The reader may figure up for himself how many million dollars the firm would have been richer had its members been able to forecast the future. It was Mr. Charles Williams, Jr., of Boston, who was destined to be rendered wealthy against his will by making telephones on credit for the Bell Company, and being paid therefor in stock instead of in cash. Those of us who were in the business in the early days remember Mr. Williams as one of the most charming of the pioneer manufacturers of electric bells, magnets, etc. He was also an excellent mechanic and a hard worker, and had a little shop at 109 Court Street. When the Bell Company found itself unable to make the arrangement it wished with L. G. Tillotson & Co., it asked Mr. Williams to do some work for it, and being unable to pay him in cash, finally persuaded him, much against his inclination, to accept instead original Bell stock. Mr. Williams did his best to dispose of this stock to his customers and workmen at 25 cents on the dollar, but they insisted on ready money, and he at last had a trunk full of the stock, which he kept because he could do nothing else with it. When the company settled its difficulties with the Western Union and began to license local companies and to pay large dividends, the stock, as every one knows, not only became exceedingly valuable, but each of the original stockholders, like Mr. Williams, received three shares for each share he had at first held. Mr. Williams has long ago retired from active business, one of the many who have acquired a competency through the invention of Alexander Graham Bell.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., Oct. 9, 1896.

EXTENSION.—It is reported that the Canadian Electric Railway Company is to make many improvements. The Canadian Company expects to receive a right of way on the new Suspension Bridge at the Falls it a price can be determined upon. The extension of the road along the Canadian side of the river to Fort Erie and Niagara-on-the-Lake is contemplated.

MR. WILFRED PHILLIPS has succeeded Mr. Ross McKenzie in the management of the Niagara Falls Park & River Railway. Mr. Phillips has been chief electrician of the road for the past three years, and Mr. McKenzie is one of the best-known railway men in Canada. He leaves the Falls for Montreal, where he will be connected with the Canadian Pacific Railway.

NIAGARA POWER IN BUFFALO.—Secretary W. B. Rankine, of the Niagara Falls Power Company, has arrived at the Falls, and is looking over the work of enlargement and transmission work. The force at work in the pit is making great progress, and the poles and line construction is moving ahead steadily. Mr. George Urban, Jr., of the Power Distribution & Conduit Company, says there has been no hitch, and that current will be ready for use in Buffalo by Nov. 15.

THE BUFFALO TRACTION COMPANY has filed papers with the County Clerk, representing the consents of property owners to the laying of tracks on Plymouth Avenue, Hamburg, Michigan, Niagara and many other streets; also on Bailey, Fillmore and Delevan Avenues. The consents give permission for laying of double-tracked surface railways and permission is also given to the laying of necessary switches, erection of poles and the use of electricity as a motive power. This company is the one promoted by Mr. Tom Johnson of Cleveland, and during the past year has been fighting for a franchise, being opposed by the Buffalo Railway Company.

ELECTRIC LIGHT IN HAMBURG.—The contract for lighting Hamburg having expired, it was decided by the trustees that the old rate of $70 per year per lamp of 2000 candle-power was too high. The proposition made to the Hamburg Water & Electric Light Company was at the rate of $62.50 per lamp per year. This proposition was refused, the company holding out for $65 per year per lamp. No agreement has been reached as yet. The company claims there is no profit at these figures. The trustees claim there are other parties who stand ready to put in an electric light plant, and light the village for considerably less than has been paid during the past three years.

BUFFALO TO CELEBRATE.—Buffalo will fittingly celebrate the arrival of Niagara Falls power about Dec. 1. It will surely be here, the Transmission Company says, so that it may be used in the celebration early in December. A dozen representative citizens met at the Merchants' Exchange to discuss the question of celebration. The first desire of those who called the meeting was to ascertain if it was the wish of the Buffalo business men to make a celebration of the event. It was decided to hold a meeting at the Exchange, to which all the leading business men will be invited. It is probable that the celebration will take the form of a general illumination of the streets and a banquet of business men, at which the glories of Buffalo as an electric city will be sung. Guests will be invited from other cities in the State to participate in the celebration. Some sort of an electrical display will be arranged. Definite plans will be arranged at the next meeting. At that time Mayor Jewett may be asked to appoint committees to take charge of the arrangements, so that the celebration may have an official character.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Oct. 9, 1896.

UNDERGROUND WIRES.—An order has been introduced into the Chelsea (Mass.) Board of Aldermen to have all the electric wires in that city placed underground.

MR. D. A. ANDREWS, JR., Treasurer of the Pettingell-Andrews Company, Boston, is receiving congratulations over the advent of a little daughter—the first to brighten his charming home and wedded life.

OUR CONGRATULATIONS and best wishes are extended to Mr. Frank E. Gilbert, of the Columbia Electric Company, Worcester, Mass., who was united in marriage, Oct. 8, to Miss Florence Malbone Dodge, also of Worcester.

MR. J. E. SAYLES has been appointed the New York agent of the American Electric Heating Corporation. This company is doing an excellent business, the approach of cold weather greatly stimulating the demand for heating apparatus.

FISHER & CRAMPHORN, Congress and A Streets, Boston, manufacturers of electrical specialties, such as the "Lyon" brake handle, station switches of all kinds, fuse blocks and holders, wire terminals and connectors, and an electric door lock, possessing especial merit and advantages, are doing a very nice business, and they deserve it.

THE BEACON LAMP COMPANY, now of New Brunswick, N. J., will be represented in New England by Mr. S. S. Sherman, its office being located in the Hathaway Building, 620 Atlantic Avenue, Boston. Mr. Sherman is a veteran in the lamp business, and has for years been connected with the Beacon Company. Popular and energetic, he has always commanded a good trade, holding and increasing customers straight along.

MR. JAMES I. AYER, General Manager of the American Electric Heating Corporation, Boston, is taking a few days of much needed rest in New Hampshire. As is well known Mr. Ayer is a hard and indefatigable worker, and his energy has been almost ceaseless in order to place the American Electric Heating Corporation on the excellent business basis it now occupies, and his friends and all who know him will wish him a most pleasant and enjoyable vacation although necessarily brief.

THE LACONIA CAR COMPANY, Laconia, N. H., which, through General Manager Putnam, recently petitioned for a receiver, is a corporation of which New England has always felt proud. It seems a pity for the old Laconia Car Company to go into the hands of a receiver just at this time. Some means ought to be devised to keep the plant intact until the revival of business next Spring. The best way to do this would be for some of our New England railways to give it a good order.

FROM BOSTON TO NEW JERSEY.—General Manager J. T. Hambay has closed the Boston factory of the Beacon Lamp Company, and the company will henceforth be located at its spacious new factory at New Brunswick, N. J. The new plant is a building especially constructed for the manufacture of lamps, the main portion of which contains 30,000 square feet. It is equipped with new and most modern machinery. It also has its own gas and electric plant, and on the whole it is one of the most complete plants in this country. That continued good fortune may attend the future of this company is the wish of its numerous Boston and New England friends and customers. Under the direction of Mr. Hambay, the company has been doing a profitable busi-

ness. He is practical in e ectrical knowledge, careful and energetic in business management, and thoroughly familiar with incandescent lamp manufacture. Mr. Hambay secured the first patents on mechanical vacuum pumps for exhausting incandescent lamps three years prior to any other, therefore, it is not at all surprising that he should attain business success. It may not be generally known, but it is, nevertheless, a fact that Mr. Hambay is quite a veteran in electrical work, having for upward of 11 years been identified with Mr. Geo. Westinghouse, Jr., in connection with the Union Switch & Signal and Westinghouse Electric & Manufacturing Companies, during which time Mr. Hambay invented and patented the Union switch and signal system, which is known as the standard, and there stands to his credit to-day, in the magnificent Union Station, Boston, many of the most important electrical appliances in connection with the movement of trains and the locking and interlocking of switches. Mr. Hambay resigned from the Westinghouse-Union Switch & Signal Company to assume the management of the Beacon Lamp Company, being one of its largest stockholders.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
927 Chestnut Street,
PHILADELPHIA, Pa., Oct. 9, 1896.

CIRCUIT-BREAKERS.—The Cutter Electrical & Manufacturing Company, Philadelphia, Pa., announces a new edition of its circuit-breaker catalogue. This edition will be known as the "Engineers'" edition. It will be of a size convenient for carrying in the pocket, handsomely printed in two colors and artistically bound. A few pages are devoted to the important details of the well-known C-S. switch. A copy of this catalogue may be had on application.

FRANKLIN INSTITUTE.—An announcement and programme of lectures for the season 1896-7 of the Franklin Institute, Philadelphia, Pa., has just been issued Among the lectures to be delivered and of interest to the electrical fraternity are the following: "X-Rays," by Prof. E. J. Houston, Oct. 30; "The Manufacture and Development of Carborundum at Niagara Falls," by Mr. Francis A. Fitzgerald, Friday, Dec. 11; "Applications of Electricity in Gold Mining," by Mr. H. M. Chance, Dec. 18; "Electricity in Warfare," by Lieut. Bradley A. Fiske, Jan. 4, 1897; "Artificial Light: Modern Methods Compared—Electric, Incandescent, Welsbach, Acetylene," by Prof. D. S. Jacobus. March 12, 1897.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, ILL., Oct. 9, 1896.

DOUBLE-CARBON LAMP DECISION.—The appeal of the Brush Electric Company against a decision holding that its double-carbon lamp patent was not infringed upon by the Western Electric Company, Chicago, has been lost. and the opinion below affirmed.

FRANCHISES.—The Century Power & Electric Illuminating Company has petitioned for a franchise to lay conduits and string wires. The Williams Publishing Company also presented a petition asking for the right to lay conduits and string wires to supply electric lighting, and this was granted.

MR. JAMES McLAUGHLIN, 586 Fulton Street, Chicago, is handling a recently patented arc lamp which is simple and said to be cheap to manufacture. It will operate on all arc circuits of 5 to 12 amperes, also on railway and incandescent circuits. Mr. McLaughlin is a pioneer in arc lighting and is well qualified to judge of the merits of lamps of this class.

IMPROVED BUSINESS.—The Davis & Egan Machine Tool Company, Cincinnati, O., reports a general improvement in its business during the past two weeks. It has received quite a number of good orders from various parts of the United States, and its foreign business continues good. Inquiries are plentiful and a brisk trade immediately after the election is anticipated.

TO REORGANIZE.—The plants of the New York Electrical Supply Company and the Orient Electric Company, both of which concerns failed recently, have been sold to John Shaw, who represented local interests. The purchase price is said to have been $2500. The creditors who purchased the property will hold a meeting and arrange for the carrying on of the business of the two concerns under one management.

TELEPHONE LINE MATERIAL.—The demand for telephone line material during the past year has been one of the features of the electrical supply business, and has tended to somewhat relieve the depression caused by the smallness of the demands for electric light material. The Electric Appliance Company, Chicago, was one of the first companies to recognize this demand and prepare for it by putting in a liberal stock of telephone line material. It is carrying in Chicago immense stocks of special telephone cross arms, pony insulators, galvanized telephone wire, etc., and is at present prepared to supply almost any demand for these goods.

EUGENE MUNSELL & CO., Chicago, will have an exhibit at the St. Louis convention which will consist of Micanite in its various forms, such as commutator segments, rings, tubes, troughs, insulating cloth and paper, and peculiar forms of insulation for various types of electrical machinery. They will also exhibit mica as it comes from the mines. Their exhibit will be one of special interest to electricians and superintendents of motor equipments. Both the Mica Insulation Company and Eugene Munsell & Co. exhibits will be in charge of Charles E. Coleman, manager of the Chicago branch. A very pretty little mica souvenir has been gotten up, and will be given to the visiting delegates. A generous supply of blotters will also be distributed, which will remind the visitors of the fact that when they reach home, the place to send their orders for insulation in any form is at 218 Water Street, New York, and 153 Lake Street, Chicago.

GENERAL SUPERINTENDENT H. C. DODGE, of the Standard Telephone & Electric Company, Madison, Wis., reports having closed contracts for the following equipment during the past 30 days: 100 drop switchboards and telephones for Delhi, N. Y., exchange; Covington, Ind., 200 number switchboards and 60 telephones; Palmetto, Fla., 25 number outfit complete; Rice Lake, Wis., 60 number central office equipment and 60 telephones; Jacksonville, Fla., one 100 number section of switchboard to meet requirements of growth of the exchange system in that place and 100 telephones; Bancroft, Ia., 50 number exchange equipment complete; Winchester, Ind., 50 number outfit complete; Union City, Ind., 50 number outfit complete La Crosse (Wis.), Telephone Company, switchboard for city fire alarm headquarters; Braidentown, Fla., equipment for 50 number exchange; Elroy, Wis., equipment for 40 number exchange, with outlook for sales for present month most favorable.

General News.

NEW INCORPORATIONS.

THE NEW JERSEY TROLLEY WHEEL COMPANY, Gloucester, N. J., has been incorporated by Dr George E. Reading, William Moore and William Johnston.

THE MONTGOMERY CONSTRUCTION COMPANY, Baltimore, Md., has been incorporated by George E. Teeple, Charles H. Byrne, Henry W. Williams, and N. Winslow Williams.

THE MORRISON BATTERY COMPANY, Cleveland, O., has been formed by Augustus Morrison, Arthur R. Bullock, Edward E. Eagle, H. L. Smith and John M. Friend. Capital stock, $10,000.

THE FLEISCHHAUER ELECTRIC LIGHT & POWER COMPANY has been incorporated to operate in New York City. The directors are John Keenan, Jacob Fleischhauer and Julius Fleischhauer, New York City. Capital stock, $10,000.

THE ELECTRIC LIGHT, POWER & CONDUIT COMPANY OF ST. LOUIS, St. Louis, Mo., has been incorporated with a capital stock of $50,000. The incorporators are S. M. Dodd, J. C. Van Blarcom, James W. Bell and James Campbell.

THE THERMO-ELECTRIC FAUCET COMPANY, Portland, Me., has been incorporated for the purpose of manufacturing and dealing in electrical devices. The incorporators are W. F. Hersey, N. C. Hersey and A. P. Nelson. Capital stock, $500,000.

THE NEWTON ELECTRIC LIGHT, HEAT & POWER COMPANY, Newton, N. J., has been formed with a capital stock of $25.000. The promoters are Julius A. Skelton, Brooklyn; Harry Skelton, Andrew Van Blarcom and John Huston, Newton, N. J.

THE ELECTRIC GAS, LIGHT, HEAT & POWER COMPANY, Pittsburg, Pa., has been incorporated in West Virginia. The promoters are Henry Hubbard, John McCarvey, C D. Williams and Ralph Theophilus. Capital stock, minimum $50,000, maximum $1,000,000.

THE PEOPLE'S ELECTRIC & MANUFACTURING COMPANY, Speers, Pa., has been formed for the purpose of supplying electric light, heat and power. Those interested are Robert J. Linton, Belle Vernon, Robert Linton, and W. W. Straub, Pittsburg. Capital stock, $50,000

THE COMMERCIAL CONSTRUCTION COMPANY, New York, N. Y., has been incorporated for the purpose of constructing electric railways, electric light plants and subways and deal in electrical supplies. The directors are: George Hilliard, George M. Still and Archibald J. Martin. Capital stock, $10,000.

THE U. S. ANIMATOSCOPE COMPANY, San Francisco, Cal., has been incorporated for the purpose of manufacturing and selling a mechanical or electrical apparatus for throwing upon canvas moving objects and figures. The incorporators are William E. Wright, Benjamin K. Badger, Gustave Walter, Charles L. Ackerman and J. E. Bein, San Francisco. The capital stock is $25,000.

TELEGRAPH AND TELEPHONE.

MONROE, MICH.—A company has been organized in this place to construct a telephone system to connect various points in this section.

FORT WAYNE, IND.—The Central Union Telephone Company has made arrangements to construct a new line between this city and Huntington.

FORT WAYNE, IND.—Early in the morning of Sept. 29 one of the wires of the Jenney Electric Light & Power Company came in contact with a wire of the Home Telephone Company, resulting in the destruction of 300 telephone instruments and the serious damage of the telephone exchange switchboard.

ELECTRIC LIGHT AND POWER.

WESTCHESTER, N. Y.—The Portchester Consolidated Gas & Electric Light plant is advertised to be sold at auction.

GRAND HAVEN, MICH.—In the election for a new electric light plant, the proposition was carried by the requisite two thirds vote.

HOLLIDAYSBURG, PA.—The question of providing a combined street lighting system will be submitted at the November election, the cost not to exceed $18,000.

CAMDEN, TENN.—A move is being made to have an electric plant here and light the town by electricity. As a good list of subscribers has been procured, it is probable that Camden will have electric lights before next Summer.

SAVANNAH, GA.—The recent storm in this city caused a great deal of damage to electrical property, entailing a loss of about $100,000. Electric light, telephone, telegraph, police and fire alarm wires were prostrated in every direction.

THREE RIVERS, QUE.—The North Shore Power Company is being incorporated as an electric light and power company, with headquarters at Three Rivers, for the purpose of supplying electricity for light, heat and power to operate the railways.

MIDDLETOWN, O.—The Middletown Edison Electric Illuminating Company has been placed in the hands of a receiver in a suit brought against that company by the Crouse-Tremaine Carbon Company, Fostoria, O. Mr. G. N. Clapp has been appointed receiver.

APPLETON, WIS.—Referring to the introduction of steam-power by the Appleton Electric Light & Power Company, it may be stated that the steam is not intended to entirely take the place of the water-power, but it was put in simply to provide against the possible contingency of the Government shutting off the use of the water. On account of the navigation the Government shuts off the water from partial use for two or three weeks, and it is for such contingencies that the steam plant was provided.

THE ELECTRIC RAILWAY.

UNION BRIDGE, MD.—It is rumored that the Frederick Electric Railway will be extended to the fair ground.

BEAVER FALLS, PA.—The project to build an electric road from Beaver Falls to Patterson's Heights has again been revived.

SCRANTON, PA.—The Traction Company secured a permit for laying tracks on Spruce Street, between Adams and Jefferson Avenues.

RICHMOND, VA.—The Common Council granted a franchise to the Richmond Traction Company to run a line through various streets of the city.

MADISON, WIS.—The bondholders of the Madison Street Railway Company have under consideration the extension of the street car lines into the cemetery.

SYRACUSE, N. Y.—An electric road is projected from this city to Split Rock. The survey for same is almost completed and the company is about to be incorporated.

JOHNSTOWN, PA.—The contract has been awarded to John R. Caldwell, of Indiana, for locating and surveying the route from Ninevah to Johnstown. The new road will be built.

NEW BRITAIN, CONN.—The Central Railway & Electric Company has decided to build its new car storage-house out near the electric field. Work will be begun upon it at once.

BROCKTON, MASS.—It was made evident at the meeting of citizens of East Bridgewater, held in that town, that they are anxious to have an electric road to connect their town with Brockton.

WEST CHESTER, PA.—William S. Kirk, president of the Suburban Railway Company, of West Chester, proposes to build a trolley road from West Chester to Philadelphia in the near future.

SOUTH FRAMINGHAM, MASS.—The Framingham Street Railway Company has asked for permission to change its motive power from horse to electric on the Union Avenue line to Framingham.

MONTREAL, QUE.—Messrs. Hogg and Morgan, of this city are busily engaged attending to expropriations at Longue Pointe, connected with the construction of the Chateauguay & Northern Railroad. The arbitrators are Messrs. Brodie, for the company, J. P. B. Casgrain, for the proprietors and Mr. Louis Allard, as third arbitrator.

PERSONAL NOTES.

MR. L. GRIMMESEY, manager for Bagnall & Hilles, Yokohama, Japan, is on a visit to this country, after an absence of seven years He is in the East. Mr. Grimmesey will return to Japan about Dec. 1, next.

MR. ROBERT A. ROSS, until recently connected with the Royal Electric Company, Montreal, as chief electrical engineer of its lighting and manufacturing interests, has opened an office as consulting engineer at 17 St. John Street, Montreal. Mr. Ross will do a general electrical and mechanical engineering business, and will give special attention to the installation of steam and electrical plants and special machinery.

MR. CHARLES F. MEDBURY has recently been acting as consulting engineer to Mr. Beemer, of Quebec, Can., who has organized a company to build an electric road in that city. There will be 17 miles of track. The power will be supplied from Montmorency Falls, the Montmorency Power Company furnishing the same from its alternating-current mains, the current being transformed by a rotary transformer. Operations will be commenced in the early Spring.

MR. JAMES RICH STEERS, of the firm of A. K. Warren & Co., of this city, was married on Wednesday, Oct. 7, at "Clover Nook," Scarsdale, N. Y., to Miss Mary Dolores Beales, daughter of Mrs. James A. G. Beales, and granddaughter of the late Eugene Kelly. Owing to the illness of Mrs. Beales the invitations to the wedding were recalled, and none but members of the family were present. In addition to being well known in electrical circles, Mr. Steers has the distinction of being a nephew of James Steers, the builder of the racing yacht *America*, the achievements of which are dear to all Americans. He is also a graduate of Columbia College. Mr. and Mrs. Steers have the best wishes of the electrical fraternity for a long and happy wedded life.

Trade and Industrial Notes.

PROF. RÖNTGEN has written to Mr. Edward P. Thompson acknowledging receipt of Mr. Thompson's book on Röntgen-rays, which he says he has read with great interest.

THE H. B. CAMP COMPANY, Aultman, O., is furnishing the Central Union Telephone Company over 50 miles of conduit for Indianapolis alone this season, besides which its ducts are being laid at Columbus, and Toledo, O.

FLEMING & POILLON, 39 and 41 Cortlandt Street, New York, selling agents for the Commercial Electric Company, Indianapolis, Ind., are meeting with much success in this city and vicinity. Mr. Fleming reports having closed some excellent orders recently.

FLEXIBLE SHAFTS.—The Stow Manufacturing Company, Binghamton, N. Y., expects to exhibit a track drilling machine at the St. Louis Convention. The company is very busy in filling orders for these equipments, which are meeting with much favor among railway people.

PACKARD LAMPS.—The New York & Ohio Company, Warren, O., has just issued a handsome catalogue of its well-known Packard high-grade incandescent lamps, including its Mogul lamp. Lamps of the various designs are artistically illustrated. Packard lamps are made in any candle power from 5 to 500. A price list of the various lamps is also given in the new catalogue.

THE BALL ENGINE COMPANY, Erie, Pa., the well-known builder of automatic engines for electric purposes, has recently shipped several engines to Mexico and one 200-hp to Russia. It has an order at the present time for one 400-hp vertical cross compound condensing engine, direct-connected to a Siemens-Halske electric generator, to be used for electric power in a large steel works at Marlepol, Russia.

TRANSFORMERS.—The Wagner Electric Manufacturing Company, St. Louis, Mo., reports that the October central station business is on the increase, due not only to the increase in individual consumption but in part to new connections. The Wagner transformer is said to be meeting with a very satisfactory demand for this new business. The company has just issued its monthly celluloid calendar for use on its souvenir transformer inkwell.

THE HELIOS CATALOGUE.—The Helios Electric Company, 1221-1229 Callowhill Street, Philadelphia, Pa., has issued a very neat catalogue of its well-known arc lamps. These lamps are manufactured for every system of incandescent electric lighting, alternating or direct current, and have established for themselves an excellent reputation for efficiency, utility and reliability. The catalogue gives some very interesting information regarding arc lamps in general and special information regarding their control and operation. Taken altogether the catalogue is a valuable production of its kind. It is well illustrated with views of the various styles of lamps manufactured by the company and diagrams of connections, etc.

THE BUFFALO FORGE COMPANY, in its "B" 1896 catalogue gives excellent descriptions of its various styles of horizontal and upright engines. These machines are especially fitted for electric lighting and general power service. They may be connected direct or by belt and are extensively employed for central station work, and for isolated plants. These machines are said to possess high efficiency and are up-to-date in design. The company has a very large plant located in the central part of the city, which is fully equipped with all of the modern appliances and conveniences suitable for the carrying on of a business of this character. Intended purchasers of engines will do well by consulting this company before placing their contracts.

ELECTRICAL NOVELTIES.—Electrical household novelties are not so frequently produced as the more practical things, but those manufactured by the Birdsall Electric Company, 231 Broadway, New York, are really attractive and popular. They will no doubt increase in demand as the holiday season advances, as they certainly make very desirable presents. These novelties represent a great variety of subjects. There are artificial flowers of all kinds lighted by tiny incandescent electric lamps, whose current is supplied by small cells of Birdsall dry battery. The flowers are potted in handsome jars and jardinieres, which enclose the batteries underneath, and by simply pressing a button the flowers become illuminated. Other forms of jardinieres contain musical boxes which give forth music and the lights are turned on and off at the same time, giving a beautiful effect.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, 105 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCT. 6, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

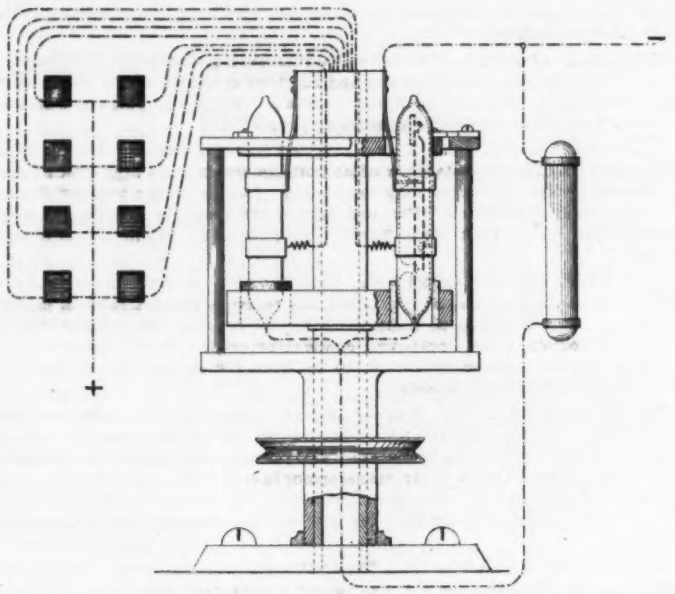
568,740. ELECTRIC SLIDE FOR CHANDELIERS; G. J. Carson, Chicago, Ill. App. filed Oct. 23, 1895. The combination with a tubular fixture or chandelier, of a tube having on its inner surface electric conductors insulated from said tube but exposed interiorly, a hollow rod to operate in the tube, an insulated piece secured in the upper end of said rod, straps, secured in said insulated piece, a block located between the straps and carrying spring-actuated contacts, electric connections with the contacts, and passing through the rod, and electric connections with the conductors in the tube.

568,756. INSULATED ELECTRIC CABLE; M. Guilleaume, Mulheim-on-the-Rhine, Germany. App. filed Nov. 25, 1895. An electric cable or conductor furnished with insulating material arranged inside and outside alternate convolutions of windings of fibrous material.

568,783. SWITCH FOR ELECTRIC HEATING DEVICES; J. E. Meek, New York, and F. L. Powers, Brooklyn, N. Y. App. filed May 13, 1895. A

switch for electrical apparatus, comprising a rotatable make-and-break-circuit device, enclosed within an exterior casing, the axis whereof is transverse to the axis of the make-and-break-circuit device.

568,798. ELECTRIC ARC LAMP; R. Schefbauer, Hoboken, N. J. App. filed Sept. 24, 1895. The combination with the carbon holders and a chain or cord connected at its ends to the carbon-holders of a frame, pivots on which said frame can be rocked, a sprocket wheel for the chain, gearing and a fly-wheel carried by the rocking-frame, a stop-weight and a separate stationary support for the same, and an electromagnet and connections therefrom for swinging the rocking frame and moving the fly-wheel into contact with the weight or away from the same.



568,863.—Means for Generating Electric Waves or Oscillations.

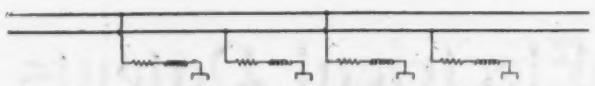
568,838. NIGHT SIGNALING; R. O. Crowley, Elizabeth, N. J. App. filed Dec. 12, 1895. The combination in a signaling apparatus, of several separate chambers, each having an all-round opening, differently-colored stationary glass coverings for the several openings, co-operating electric lights in the chambers, and means for controlling the lights to illuminate the colored glasses in the desired order.

568,840. TELEPHONE SWITCHBOARD; L. W. Davis, Mineral, West Va. App. filed Dec. 5, 1895. In a telephone-switch, a series of contact-plates, connected with a call-bell, a series of contact-plates each connected to a different line-wire, the central instrument and contact-rods and ground connections and plugs.

568,849. STATION OR STREET INDICATOR; E. B. Lodge, Cleveland, and W. R. Lodge, Cuyahoga, O. App. filed June 15, 1896. In a station or street indicator, the combination of a box, posts, rollers, a ribbon having station or street names printed thereon, a shaft journaled in brackets, a sprocket wheel on said shaft, a chain belt connecting said sprocket with pinions on the ribbon-rollers, a notched wheel on the opposite end of the shaft, an electromagnet supported on a bar, a pivoted frame connected with the cores of the electromagnet, a lever on the hub of said notched wheel, a connecting-rod connecting the frame with said lever, and a pawl on the end of the lever engaging with the notches in the notched wheel.

568,861. ELECTRIC ARC-LAMP; N. G. Meade, Jamestown, N. Y. App. filed May 15, 1896. In electric arc-lamps, a screw clutch composed of a collar, a ratchet wheel, a spring, a pair of hinged jaws in combination with a beveled collar and means for actuating the clutch.

568,863. MEANS FOR GENERATING ELECTRIC WAVES OR OSCILLATIONS; D. McF. Moore, Newark, N. J. App. filed Dec. 7, 1895. An improvement in generating electric waves, oscillations or disturbances by interruptions of a circuit of induction, consisting in momentarily interrupting in succession a series of such circuits, turning the electric waves, vibrations or disturbances produced by each interruption into the working circuit common to said circuits of induction, and in the intervals between interruptions of each circuit and during the operation of other circuits, connecting each circuit to a source of electric energy.



568,964.—Electric Cable.

568,918. RAIL-BOND; H. S. Newton, Syracuse, N. Y. App. filed Aug. 10, 1896. In a combination in a rail-bond, the bond wire, contact plates positively attached to the ends thereof, having flat inner faces, covered with tin or solder for making contact with the side of the rail, and means for securing the bond in position.

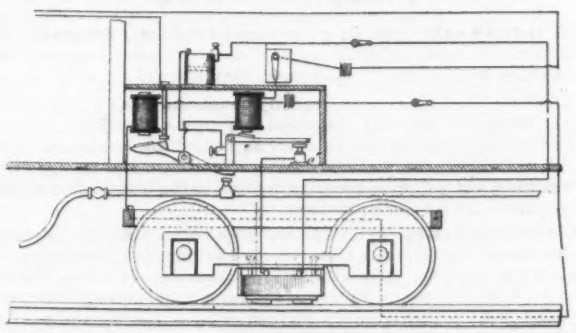
568,919. SOCKET FOR INCANDESCENT ELECTRIC LAMPS; J. Pass and A. P. Seymour, Syracuse, N. Y. App. filed Feb. 14, 1896. In a porcelain socket, the combination of the body and the base, the adjacent faces of both being provided with depressions and integral projections, and fitted to each other so as to form an arcing-chamber, substantially circular in cross-section and comparatively narrow in the direction of the axis of the socket, contact plates attached to said faces, positively separated from each other by said projections and depressions when the parts are assembled, and means for connecting the body to the base.

568,947. OSCILLATING RECIPROCATING TRIPOLAR ELECTRIC MOTOR; T. H. Hicks, Detroit, Mich. App. filed Dec. 19, 1892. In a reciprocating electric motor, the combination of a solenoid core-wound with two conductors, a piston, the two conductors being alternately traversed by a current of electricity; the current when flowing through one conductor causing the piston to move in one direction in the axis of said core, and when flowing through the other conductor causing the piston to move in an opposite direction.

568,964. ELECTRIC CABLE; S. P. Thompson, London, England. App. filed Dec. 19, 1893. In an electric cable for submarine use consisting of a main copper conductor continuous from end to end, surrounded by an insulated sheathing and furnished at regular intervals along its length with branch conductors all of equal high resistance and equal self-induction, each such branch conductor consisting of a metallic core joined into the main conductor and of an insulating sheath extending all along its length and continuous with the insulating sheath of the main conductor, the outer end of each such branch being earthed.

568,971. MULTIFUSE CUT-OFF; W. Ehrhardt, Union, N. J. App. filed Dec. 23, 1895. A multifuse box or cut-out, comprising a base, supports fastened to said base, a spindle having a handle or handles journaled in said supports and acting as an axle, a cylinder fastened to said axle revolving with said axle by imparting rotation to the handle, depressed or countersunk portions in face of cylinder, holes in depressed or countersunk portions of cylinder and extending below the surface of said depressed portion, plugs fastened in said holes, conducting contact-plates containing holes, the centre of which coincides with the centre of the plugs and placed in the depressed portions of cylinder, screws or the like to retain the contact-plates in depressed portions, fusible strips or wires connected to contact-plates, conducting-brushes or springs, one of which presses against contact-plates, the other fastened to the base and having terminals for the circuit-wires.

568,993. LOCK AND BLOCK SIGNALING ON RAILWAYS; W. R. Sykes, Jr., and J. P. O'Donnell, London, England. App. filed Feb. 6, 1895. In a system of signaling on railways, the combination with single-needle instruments operatively connected together, of a treadle, an electromagnet provided with an armature, a battery, a second treadle and a wire connecting the said treadles and electromagnet with the battery, a polarized relay included in the block-circuit of the instrument, a local circuit holding the armature in contact with the electromagnet after the same has been energized, contacts, and a signal catch-handle for connecting them, a second battery, a wire connecting with the starting signal and to the contacts and said second battery, a tongue connected with the relay and a contact connected to the wire, the said starting-signal not being free to be operated until after the first said treadle has been depressed, the energizing magnets and the tongue has been placed in contact with the contact by means of the "line-clear" current from one of said instruments.



569,101.—Automatic Electromagnetic Brake for Railway Cars.

569,018. TELEPHONE; A. Gartner, Newark, N. J. App. filed Feb. 15, 1896. The combination with the telephone received and its diaphragm, of a series of balls arranged in the receiver and forming an annular bearing for one side of the diaphragm, and an annular curved flange also arranged in said receiver, and forming the bearing for the other side of said diaphragm.

569,099. ELECTRIC CLOCK STRIKING MECHANISM; F. E. Girod, Geneva, Switzerland. App. filed Oct. 11, 1895. In clocks intended to sound the hours and halves by means of an electric bell of any well-known system whatever, the combination of a lever connected to and oscillating with the pendulum with a click intended to act at each double oscillation of the pendulum upon one tooth of a rack, the position of which is determined by the usual hour-snail, a contact lever intended to shut the circuit of the electric bell once at each double oscillation of the pendulum, and a rocking lever bearing two pins intended to put the said click and contact-lever out of action when the said rack reaches its rest position.

569,101. AUTOMATIC ELECTROMAGNETIC BRAKE FOR RAILWAY CARS; E. A. Hauerwas, Saratoga Springs, N. Y. App. filed May 23, 1895. A train-braking system comprising electromagnetic brakes adapted to engage with a track between the wheels of a truck, a normally open local circuit in which the brakes are located, a source of electricity for said local circuit, including an electromagnet controlling a circuit-closer operating to close all the local circuits of a train, a normally closed circuit, in which the circuit-closer is located and a source of electricity for said normally closed circuit.